

MICROBES
AND....
MEN.

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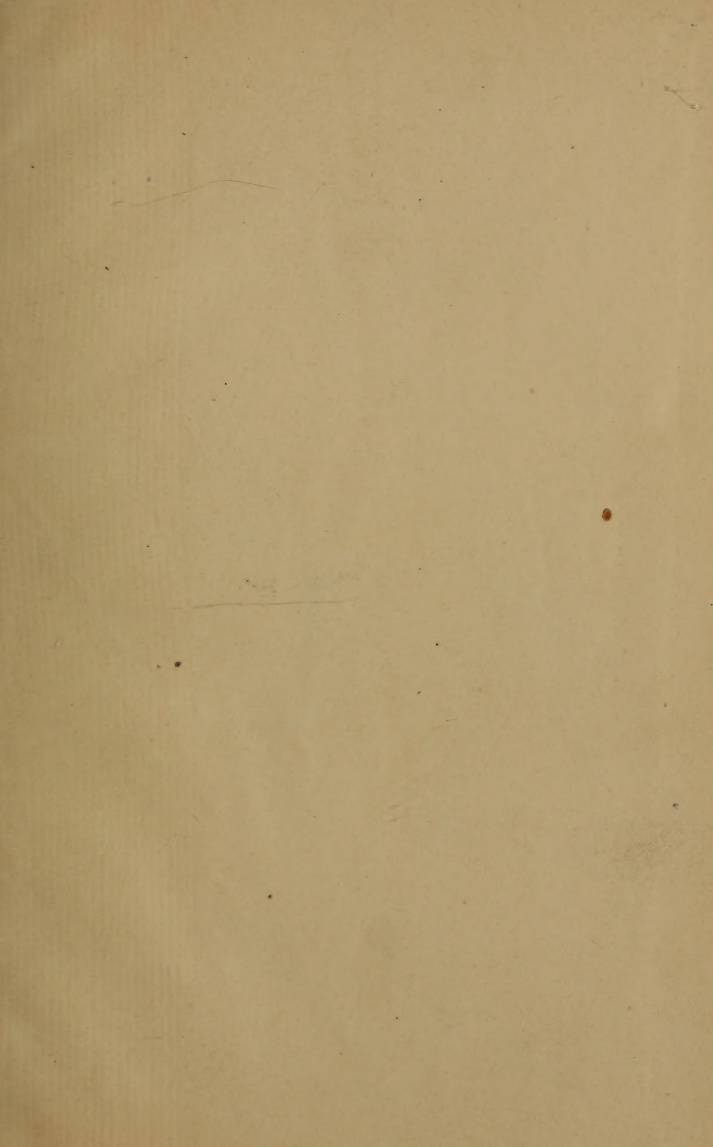
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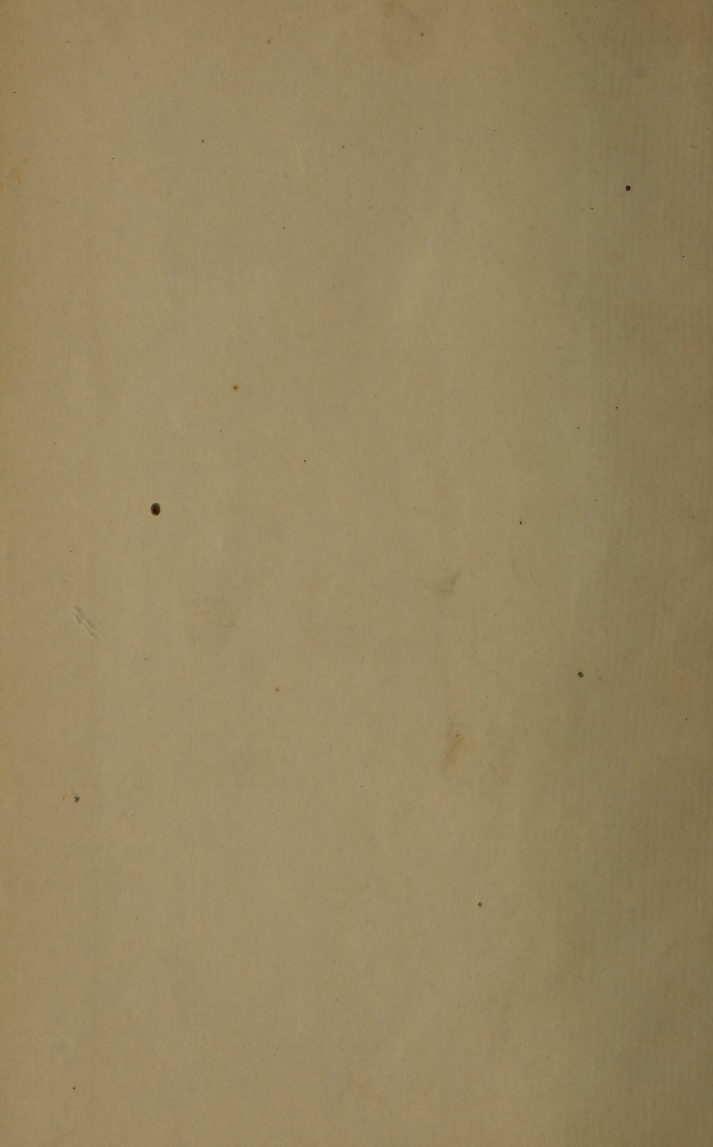
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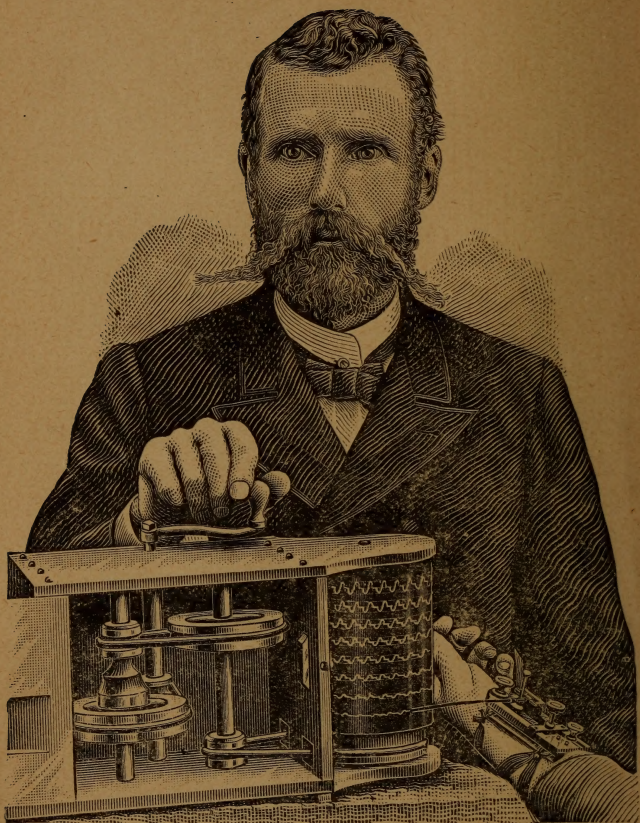
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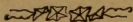


The Sphygmograph in operation by the Author.

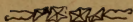
MICROBES AND MEN,

— BY —

✓
I. H. ORCUTT, M. D., PH. D.



... Illustrated ...



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PREFACE.

The purpose of this little book is to present in a plain and practical manner, some of the most interesting and valuable scientific knowledge of this decade, and to give to the public the results of a number of important experiments that have never before appeared in print. An effort has been made to reach the present limits of knowledge, and to give only such scientific truths as are capable of demonstration. A few of the facts presented and some of the conclusions reached may seem incredible to many whose opportunities for study and experiment have been somewhat limited. Great care has been taken to avoid exaggeration and misleading statements.

It is presumed that the reader has at least a limited knowledge of physiology, so that he may in some degree realize the all important fact that there is no earthly treasure so valuable as a sound mind in a sound body. Wide spread increase of the use of alcohol and tobacco, and the consequent alarming increase of certain diseases, of crime, pauperism, idiocy, insanity, and suicide, make it certain that something ought to be done in order to check the onward march of these foes to the race, and thus avert an impending crisis. All intelligent persons, *especially the young*, should know the scientific facts which have to do with the health, progress, and welfare of present as well as future generations.

Nearly two years of time, and many hundreds of dollars, would not have been spent in the production of so small a book, had it not been firmly believed that a clear understanding of truth is both the foundation and corner

stone of refrom and of correct personal living. If this brief treatise be generously accorded a place in this foundational work, leading some into well-defined paths of right-thinking and correct living, the author will be content.

Grateful acknowledgement is made for the kind aid received from many sources. Rev. S. A. McKay, A. M., read the manuscript and proof, making many valuable suggestions. The writer's friend and co-worker for over seven years in the Agricultural College of South Dakota, Robt. F. Kerr, A. M., has copied the manuscript and otherwise assisted in getting it ready for the press. Earl Douglass, John Fansett, H. F. Craig, and many other former pupils have assisted in performing 45 series of experiments, each of which usually occupied one half day. Still others have rendered a like assistance.

Nearly all the illustrations are either sphygmographic traces or pen drawings by the author. A few of the latter are intended to assist in teaching truth, not being exact reproductions of microscopic views.

July 16, 1894.

I. H. O.

MICROBES AND MEN.

CHAPTER I.

MICROBES.

During the past few years a new and very valuable science has come into being and is receiving an increasing amount of attention. Originating mainly in France, it has gradually extended over the whole civilized world. This new science is known as Bacteriology, and is now generally taught in universities, progressive colleges, and medical schools. It treats of the lower forms of life of which we have knowledge, especially of disease germs, and those germs which cause fermentation and all forms of decomposition. The word *bacteria* being somewhat restricted in its meaning, is, in popular writing, being generally displaced by a better term, that of *microbe*. This latter term is applied to all minute living beings. Some microbes are known to be plants and others animals, but in the majority of cases scientists are in doubt as to their proper classification. Whether

they be plants or animals is of little consequence, provided we are able to learn something of their life history. It is certain that, with few exceptions, they subsist like animals, in that they do not create complex organic substances out of inorganic matter, but live by destroying what has already been formed directly by plants, or indirectly by animals.

Their life work is, therefore, as truly destructive as that of the higher animals, who them-



Fig. 1—Microbes of malaria highly magnified.

selves live upon the stored-up energy of lower forms. In the process oxygen is consumed and carbonic acid gas is thrown off, along with other waste products, just the same as with

man and other animals. Microbes which cause

disease are as truly parasites as are ticks and tapeworms. When a person has malarial fever he is as certainly being destroyed by animals as if attacked by fleas, wolves or lions. A wound may be changed into a dangerous ulcer by microbes as well as by maggots.

We may well believe that there is very much going on about us, and within us, which we do not perceive with our unaided senses. Until

recent years it was believed by many that the lower forms of animal life, such as fleas, flies, bugs, worms, and even mice and rats, were brought into being by the decomposition of organic matter. The celebrated Von Helmont, who lived early in the seventeenth century, says:—"It is true that a ferment is sometimes so bold and enterprising as to form a living being. In this way lice, maggots, and bugs, our associates in misery, have their birth either within our bodies or in our excrement. You need only close up a vessel full of wheat with a dirty shirt and you will see rats engendered in it, the strange product of the smell of wheat and the animal ferment attached to the dirty shirt." These purely fanciful notions have not been able to stand the light of modern research, especially when the microscope is used which so largely increases our powers of vision.

All living things are reproduced by their kind. This is as true of microbes as it is of men. Disease germs have parents as truly as any of the more familiar animals. Such germs would not inhabit our bodies if their parents had not injured some one else and prospered. We furnish them shelter, warmth, and food till each one becomes the progenitor of a host, then send them out, by the aid of air, water, food, and clothing, to find lodgment in the

bodies of our friends and neighbors, where their life history is repeated. There are thousands of species of microbes and they are of different sizes, shapes, colors, and "dispositions," just as we find differences among the higher forms of plants and animals. In fact, so far as numbers are concerned, the invisible world has its millions where the visible world has its thousands.

Each microbe is a single cell of a substance called protoplasm. This substance appears very much like a small particle of the white of an egg. There are, however, a few colored species of these minute creatures. Blood spots on vegetable food, "blood water," "blood rain," "red snow," "blue milk," and "blue pus," are simply changes in the original, caused by the presence of colored microbes.

The microbe which causes *la-grippe* is said to be only one sixty-thousandth of an inch in diameter, requiring 216,000,000,000,000 to make a cubic inch, or thousands of millions to make a thimbleful. The average size of microbes is about one three-thousandth of an inch in length, requiring about 30,000,000,000 to make a cubic inch. It seems perfectly proper to say that they are inconceivably small.

These invisible creatures are found everywhere, swarming in the food we eat, and in

the water we drink, in the air we breathe, and in the ground upon which we walk. It is estimated that each person takes into his lungs, in the air that he breathes, an average of 300,000 microbes per day. Rain water at Paris contained 64,000 in each quart, while the water from the river showed 4,500,000 in each quart before it reached the city, and 12,000,000 after it had passed through it. It is stated on good authority, that there are about 4,000,000 of these low forms of life in each tumblerful of Lake Michigan water which is furnished to Chicago through the waterworks. As large as these numbers may seem, impure milk often shows a much greater proportion in a similar quantity. Since heat is very destructive to all kinds of microscopic life it is evident that it is a safe plan always to boil suspected milk and ordinary drinking water before using either.

These low forms of life come into being either by budding, or by fission. In the former case a bud may be seen growing out of the side of a mature microbe. It takes food independently and grows until it becomes as large as the parent and then it sends out buds producing another generation. In the case of fission the microbe is seen to contract in the middle like a figure 8 until it divides into two parts, each of which grows

till it is as large as the parent, when the process is repeated so long as the conditions for growth are favorable. In unfavorable conditions the cell, which is the complete microbe,



Fig. 2—Reproduction by budding and fission.

contracts into a small germ, spore, or seed with a covering, and this enables it to resist most destructive agencies to a remarkable degree. Some survive long periods of boiling or roasting while others are not killed in a

loaf of bread which has been fairly well baked. Disease germs may remain in clothes, old rags, or wall paper, for years and still cause disease when they find lodgement in bodies not able to resist their encroachments. As the sediment from an overflowed stream, or the bed of a marsh or lake, becomes dried, spores are produced by the drying of the microbes and are caught up and carried by the air as fine dust. It takes a powerful microscope to detect the presence of these spores, so minute are they. Natural growth of trees, or rows of cultivated trees between a house and land subject to overflow, form a valuable protection, for the reason that they arrest the flight of nearly all these dangerous spores.

It is very important that every responsible

person should have some knowledge of microbes and their influence for good or ill. With even a limited knowledge of the habits of disease germs much sickness could be avoided and many premature deaths. Every one ought to know that such diseases as barbers' itch, scarlet fever, typhoid fever, small-pox, yellow fever, diphtheria, hydrophobia, consumption, cholera, leprosy, measles, mumps, and many others, are caused by microbes and are easily communicable to other people. Many of the diseases of domestic animals, such as lumpy-jaw of cattle and glanders of horses, are caused by germs and may be communicated to man. The affected parts of all such diseased animals should be burned, not buried. It should also be well known that microbes are sometimes found in the saliva of healthy persons which, if introduced into the blood of another person will multiply rapidly and cause death. It is no safer to be bitten by a man than by a dog.

It is estimated that a person, sick with consumption, will expectorate 40,000,000 disease germs per day. This many live active microbes, deposited every day of his existence upon the streets, sidewalks, lawns, and floors, and liable to be conveyed by hands, clothing, and air into our foods, drink and lungs, is a subject which is not pleasant to contemplate.

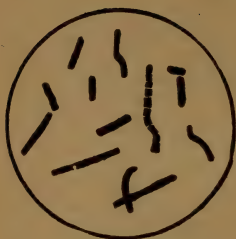


Fig. 3.—Microbes of consumption highly magnified.

Is it any wonder that a seventh of all deaths among adults in America is due to some form of this disease? *Everything coming from a person affected by a germ disease should be immediately disinfected or burned.*

The spores of disease germs may remain quiescent for years and then revive and develop rapidly when placed under favorable conditions. This will account for most of the isolated cases of scarlet fever and other diseases, which appear from time to time. Old rags or clothing, which have been infected, new clothing from "sweat shops" where filth and contagion are common, may be the

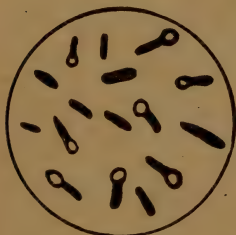


Fig. 4.—Microbes of typhoid fever highly magnified.

means of conveying such disease if brought into contact with susceptible persons. Typhoid fever germs, diphtheria germs, and other varieties, are very often thrown out in slops to be washed into our drinking water, or dried and blown about by

the wind, thereby spreading possible disease

and death through out a whole neighborhood.

It has been discovered that oysters take up disease germs, especially the bacilli of typhoid fever, from the mud and ooze in which they live, and thus communicate them to man, if eaten raw. In the canning of fruits, meats, and other foods, the process kills and excludes all microbes. This is the secret of the preservative power of the whole operation. The process was learned by the accidental discovery of some canned figs in the ruins of Pompeii. The fruit was still well preserved although nearly two thousand years had elapsed since the cans were sealed. Microbes cannot live without moisture, therefore *nothing* rots which is kept *dry*. The value of an ointment or a surgical dressing is in proportion to its ability to keep out or destroy the microbes which are being constantly deposited in an open wound by the air.

Every person has more or less natural resistance against the invasion of disease germs, some being able to resist even the germs of small-pox so completely that they never contract the disease, however often they may be exposed to it. Perfectly healthy people who live strictly according to well known laws of health are seldom destroyed by disease germs. Anything which lessens the vitality of the

body lessens the vital resistance to these destroying forces. Bad air, worry, overwork, lack of work, filth, improper food, over-eating, tea, coffee, tobacco, alcohol, opium, chloral, cocaine, or excesses of any kind, tend to weaken the vital powers and that increases our chances of being injured or destroyed by the dangerous germs which are continually entering our bodies by means of air, food or drink. ANYTHING WHICH LESSENS VITALITY INCREASES THE DEATH RATE FROM GERM DISEASES.

When an active microbe or a spore finds a favorable location for growth and development, it at once begins to produce buds, or to divide, and the little beings commence to increase at an incredible rate. It is believed that some disease germs are able to double in number every twenty minutes. Such being the case, one microbe would become two in twenty minutes; four in forty; and eight in sixty, and so on, reaching the incomprehensible number of 4,722,365,482,669,645,213,696, in twenty-four hours, provided that all conditions were favorable. If it be possible for one microbe to have so many descendants, as expressed in the above calculation, in twenty-four hours, another similar period would show a correspondingly large increase, always providing that they retain their vital-

ity and have a sufficient food supply. At the end of the second day, the number of microbes would have to be expressed by the product of the large number given above multiplied by itself. Worlds would not hold all of them. These figures are simply incomprehensible, but this very fact may help us to understand why people sometimes die so suddenly after being attacked by cholera, cholera morbus, and other germ diseases. We can also comprehend the reason why fresh meat or dead bodies tend to decompose so rapidly under certain conditions, especially those favorable to the development of microbes.

These low forms of life are the great disorganizers of nature, decomposing everything, whether plant or animal, which has been alive. They decompose the building and the builder. They reduce all complex substances which have been produced directly or indirectly from the mineral kingdom, back to their original condition. This statement includes those food substances which have been only partially changed or decomposed while passing through the bodies of animals and animal-like plants. Plants are not nourished by manure and other organic compounds until they are reduced to their mineral components by the microbes. Take all the germs from a field and ordinary crops will not grow. They

are the important links in "being's endless chain" formed and unformed, where, in the economy of nature, not an atom of matter is created or destroyed.

Many of the facts already given have been discovered by cultivating the microbes, or breeding, feeding, and caring for them, as we care for other "stock." A "culture," the name given to each separate experiment, is made by placing a few microbes in a substance which they can use as food. Here they multiply until the food is exhausted or until the substance becomes so foul, from the waste matter thrown off by the active microbes, that they are poisoned. A culture may be made in a test-tube, a barrel or a large vat.



Fig. 5.—Culture of Anthrax germs in gelatine.

Suppose an experimenter wishes to study the cattle disease known as anthrax, or splenic fever. He finds a few microbes under his microscope which he believes to have come from an animal dead with that disease. A culture is made by putting the microbes into a test-tube partially filled with some food substance. Here they multiply. Some of these young disease germs are



Fig. 6.—Microbes of Anthrax, greatly enlarged

ops into a fatal case of anthrax. These experiments are repeated till there can be no doubt regarding the cause of the disease. In a similar way disease germs are being discovered and studied.

Microbes devour their food as truly as do beasts of prey, whether that food be an apple, a dead cat, or some of the tissues of a live man.

They also throw off waste products as excrementitious matter, the same as all the higher forms of life. This refuse is poisonous to animals, in the same way that the excrement of one animal is poisonous to other animals. These poisons are found in all decomposing substances, such as tainted meat or fish, rotting fruit or vegetables, rancid butter, or old cheese.

Panum first showed that a poisonous product, resembling snake venom and such vegetable alkaloids as morphine and strychnine, is

injected into another animal which subsequently dies with anthrax. A little blood from the last victim is used in making another anthrax culture. A part of this culture is used in inoculating another animal which also devel-

developed from the putrid fermentation or decomposition of meat and similar substances. This product is called *septine*. It is the excrementitious matter thrown off by active microbes, and is so poisonous that in some cases one-fifth of a grain will kill a dog.

E.L. Trouessart, in his "Microbes, Ferments and Moulds," says:—"Panum's researches have been recently resumed by Selmi and Gautier who have extracted from corpses and putrefying organic matter a certain number of poisonous substances greatly resembling vegetable alkaloids, and termed by them ptomaines. The action of ptomaines may be compared to that of strychnine. Injected into the blood, even after the removal of every living microbe, the ptomaines produce fever, rigors, vomiting, diarrhœa, spasms, torpor, collapse, and finally death. It is probable that in some cases of poisoning by tainted meat or fish their poisonous properties are due to the presence of ptomaines.

But in all cases these ptomaines are shown to be the product of putrid fermentation, which is always effected in dead bodies by special microbes. Here the ptomaines are due to the work of the microbes of putrefaction, and are made by them, just as alcohol and the carbonic acid of alcoholic fermentation are made by yeast, at the expense of the su-

gared liquid in which they live and multiply.

Direct experiments show that when septine, from which every microbe has been removed, is injected into the human subject, it produces feverish disturbances, but only causes death when introduced in considerable quantities."

In germ diseases, the poisonous substances which are thrown off by the microbes seem to do much more harm than the pests themselves. If a culture be made of chicken cholera germs and the resultant mass be then filtered through porcelain so as to separate the germs from their excrement (ptomaine or septine) and some of the poison be injected into a healthy fowl, it will become intoxicated and remain so for a few hours. If the amount be increased it will die from excessive intoxication. If on the other hand, the germs alone are injected into the system of a vigorous fowl, they will multiply and the bird will die with the cholera, or in other words, is poisoned to death by the waste products thrown off by the germs which rapidly develop within its body. In such diseases as cholera, scarlet fever, and diphtheria, the subjects are both poisoned and devoured by the microbes which cause the disease. This fact accounts for the many sudden deaths from such diseases. It explains the sick headache and certain other symptoms in consti-

pation, for it is known that in the development of large members of microbes the ptomaines are absorbed into the system from the intestines.

Each species of microbe selects a very few substances which it always uses as its particular foods and it will not thrive upon other forms more than animals will upon food not adapted to them. These voracious little creatures eat about five thousand times more food in proportion to their size than does the average man.

In all the lower forms of life, just as in the higher forms, each species has its "personal odor," arising from the waste products which are thrown off in various ways. These odors are so characteristic that it is not difficult to distinguish, by the sense of smell, whether we are in the presence of decomposing fruits, vegetables, or meats. In fact, most people are able to name the particular varieties of fruit or vegetable that are in process of decay. The microbes which cause the excessive sweating and offensive odor of the feet of some people, or the red sweat in the armpits, give off their characteristic vile odors when cultivated in a test-tube. If a person has a marked odor it is either caused by the presence of microbes or is the result of uncleanness. Microbes and all other creatures which

live upon animal food, usually have a much stronger "personal odor" than those which live upon vegetable diet.

The decomposition of all vegetable and animal substances is called fermentation—a much broader meaning of the term than is generally supposed. "Microbes are ferments; they excrete the products of fermentation." The two words are similar expressions, and mean that the substance under process of decay or change is being eaten by microbes and that the new product is the waste which has been excreted or thrown off during the transforming process. These waste products may be inorganic compounds, such as carbonic acid gas or ammonia, or they may be organic compounds more or less like those found in the excreta of all the higher forms of life. If we make a culture from grape juice or apple juice, which contain large quantities of water, or one from grain soaked in water, the microbes (yeast) will eat the crushed fruit, or soaked grain and throw off two principal kinds of excrement—alcohol and carbonic acid gas. The gas will escape into the air, thereby causing the frothing or foaming of the mass, while the alcohol, which has an affinity or liking for water, will remain in solution.

Whenever fruit or grain is prepared for the

reception of the microbes a culture is made, whether the preparation be in a test-tube, cider-barrel, wine-cask, or beer-vat. In either case the food is as certainly intended for consumption as it would be if given to any other kind of "stock." If the fermentation be complete the food value of the article will *entirely* disappear. The liquid will contain some coloring matter and a greater or less per cent of excrement, commonly called alcohol. This latter is in no sense a food, but a product which is poisonous to all animals.

The flavors and odors of wines and other liquors depend largely upon the "personal odor" of the species of microbe which causes the fermentation. If a bushel of corn be fed to pigs and another to hens, the fact is well known, that distinct "personal odors" will be imparted to the waste products in either case, the food consumed being exactly alike. It is no less true in the case of the lower forms of life. The odor and flavor of tobacco depend largely upon the particular species of microbe which develops in it during the sweating process.

It has recently been discovered that the flavors and odors of the liquors and tobaccos of certain localities, which command such high prices, can be produced anywhere by using the right kind of microbe. Port wine

or Havana tobacco can be had by importing and propagating the kinds of microbes whose excrement has the desired "personal odor," instead of importing the articles themselves.

In closing this chapter it seems best to recapitulate briefly in order to fix in mind a few of the important points which it would be well to remember. Microbes are the smallest living creatures of which man has any knowledge. They live under the same laws—eating, growing, and multiplying—as do all the higher forms of life. Scientists class some microbes with plants and others, such as those which cause fever and ague, with animals.

Microbes live like animals by taking food into their bodies. This food is disorganized or transformed and waste products are thrown off which are poisonous to animals. Every thing which has had life is eaten and thus destroyed by them. The waste products or excrementitious matter thrown off by microbes are called ptomaines or septines—those from the decomposition of animal matter seeming to be more poisonous to man than those from the decomposition of vegetable matter. Not all microbes cause disease and not all diseases are caused by microbes.

Ordinary fermentation is the destruction of grains and fruits by microbes. A beer-vat or

a wine-vat is as truly a culture as is the test-tube of the experimenter, in which he feeds and breeds cholera germs or other microbes. In the case of the beer-vat culture the microbes are bred for the excrement, while the test-tube culture is made for the purpose of studying the microbes.

Alcohol is a ptomaine or septine and, when taken pure (absolute alcohol), is as deadly as the ptomaines of chicken cholera or putrid meats, although a larger quantity is needed to produce the same effects.

The different flavors and odors of liquors are imparted to them by the microbes that caused the decomposition of the fruit or grain. When fermentation is complete the grain or fruit has been entirely consumed by the germs, only colored water and excrement (alcohol) remaining.

A barrel of beer does not contain as much nourishment as a loaf of bread, but contains enough ptomaine (absolute alcohol) to kill, within ten minutes, thirty-five men who are not accustomed to its effects.

CHAPTER II.

BLOOD AND MICROBES.

The blood is the most important and most abundant fluid of the body. "The life of the flesh is the blood." About one-ninth of the entire weight of the body, or from twelve to eighteen pounds, is "running flesh." The blood is a liquid flesh containing only five per cent more water than is found in muscle. It is at once the provider and purifier of the whole body, receiving the digested part of the food, carrying it to every tissue, and removing the worn-out particles of matter. It contains the material out of which new tissues are made, and old ones are repaired. Blood appears red because it is packed full of little coin-shaped discs called red corpuscles. These are about one three-thousand-two hundredth of an inch in diameter and one fourteen-thousandth of an inch thick, requiring nearly one hundred and fifty billions to make a cubic inch. Each drop of blood con-

tains about 200,000,000 of these red corpuscles.

It is stated there are one hundred and seventy-three cubic inches of corpuscles in the blood of each healthy man. This estimate gives to each individual something like 25,000,000,000,000 of these little "workers." On an average, once in every two minutes, "from the cradle to the grave," each one goes to the lungs and secures a load of oxygen, which it gives up to some of the hungry tissues while it is on its rapid flight through the body. Any thing which interferes with their appointed work, even for a moment, jeopardizes the vitality and endangers the life of the individual.

For every three or four hundred red cor-



Fig. 7.—Red and White Corpuscles and Microbes of Swine Plague. Highly magnified.

puscles, there is found a white corpuscle, making seventy-five or eighty billion in the blood of each person. The white corpuscles, when at rest, appear to be transparent balls in

which are seen a number of drak specks. The white corpuscles are larger than the red, and possess the power of spontaneous movement, contracting and expanding, throwing out finger-like projections from different parts of their surfaces and as quickly withdrawing them. These movements are very similar to those of the minute animal, the *amœba*. They do not move so rapidly through the small blood-vessels as do the red corpuscles. They have power to change their shape and to pass out, something like a worm, through the blood-vessels, and, after creeping about awhile through the tissues, to go back again, by a new road, into the blood.



They appear in large numbers in wounds, abscesses, and ulcers where they are called "pus" or "matter." In certain diseases they seem to be very much more numerous than when the patient is in good health. For many years scientists have been advancing various theories in regard to the special office of the white corpuscles. These theories have been both wise and otherwise. After years of the most painstaking investigation and research, with the most approved instruments and ap-

Fig. 8.—*Amœba*. Various forms of same animal. Greatly enlarged.

pliances, one of the greatest of the many wonderful discoveries of the nineteenth century has recently been made—THE WHITE CORPUSCLES EAT MICROBES.

We now see why they do not move so rapidly through the blood-vessels as do the red



Fig. 9—White corpuscles eating microbes.
(Showing amœba-like movements.)

corpuscles, whose office is to make all possible haste to reach the lungs in order to secure a load of life-giving oxygen for the use of the famishing tissues. We are also able to understand why these white corpuscles are so numerous in certain di-

seases. The defensive army has been increased to help repel the invading forces of the enemy which threaten to overpower the whole nation—king, soldiers, and all, if the invaders are not all destroyed. The white corpuscles appear in wounds and ulcers to eat, and thus to destroy, the microbes which are being constantly deposited by the air. If these invading and greedy microbes are not destroyed, they eat the exposed flesh and throw off waste material which is absorbed by the blood vessels and blood-poisoning is the result. When a wound is kept free from microbes the white corpuscles (pus) do not appear. It is a

grave mistake to believe that a running sore purifies the system. It does no more in that direction than does a battle to purify an army. A thimbleful of pus contains more than a billion of these valiant "soldiers"—a number greater than the combined armies of the world.

Microbes feeding upon dead matter do not have to contend with these living forces, called *vital resistance*. When



Fig. 10.—White corpuscles at rest, digesting microbes.

a living being is attacked by these dangerous hordes, there ensues a terrible struggle for supremacy and life is endangered. The invasion is resisted by the existing corpuscles and by the new ones, also, which are gen-

erated to assist in the deadly combat. In this struggle many lives are lost on both sides. If the microbes conquer, all is lost—the faithful army and that for which they fought. Whether the white corpuscles are aided or hindered by the afflicted individual or by his physician, they make a heroic fight to "save the union." If they vanquish the enemy there may be enough vitality left to rebuild the constitution.

It is very interesting to witness, under a

microscope, such a heroic struggle going on in a drop of blood. Our faithful defenders, the white corpuscles, are not only willing to meet the living enemy in hand to hand conflict, but they willingly rush into the poisonous excretions of the microbes outside of the blood-vessels (as in the case of an open wound or on the membrane in diphtheria) and there sell their lives as dearly as possible, by filling their bodies, sometimes even to bursting, with the rapidly increasing invaders.

The white corpuscles are the most numerous and brave, the most simply clad and armed, the most efficient and faithful, defending army the world ever knew. We survive from day to day because of the eternal vigilance of the white corpuscles, who stand ever ready to fall upon and devour these enemies of our peaceful and much loved anatomy. It is only when the invaders are to a greater or less extent successful, that we suffer sickness or death from these daily inroads.

Much may be done both to help or hinder the work of these loyal friends in their daily warfare for our well-being. Like nearly all living beings they need a constant supply of proper food, pure water, and fresh air. If these necessary things are withheld, or improper and harmful things are provided, to that extent will the white corpuscles be impeded in their work.

The physical system, of every human being, is a government inhabited by an innumerable host of citizen soldiers, each individual of whom has inherited a marvelous degree of loyalty as well as skill and bravery. These warriors are seldom overcome, when the general government is in good order and gives them a fair chance.

They, indeed, war a good warfare, and, if suffering and death go forth at noonday, it is always because of a misgovernment of the system for which every warrior corpuscle is ready to sacrifice his life. Sometimes the unwise commander compels his army to camp where it is constantly flooded with such quantities of sewerage, (beer and cider), that the warriors are soaked and surrounded with poison, to such an extent that they are scarcely able to distinguish between friend and foe, much less to contend successfully with the enemy. Thousands of observations and many experiments on the lower animals, prove, by analogy, that a person is much more liable to suffer from germ diseases when not properly fed than when he is. "The pestilence follows the famine and death follows close upon the track of a glutton."

Debility from lack of proper exercise, or exhaustion from overwork, tend in the same direction. Sleeping and working in poorly

ventilated rooms are common ways of failing to provide the warrior cells with the necessary supply of fresh air. Thousands of cases of consumption are traceable to this cause alone. ANYTHING AND EVERYTHING WHICH LESSENS VITALITY INCREASES THE DEATH-RATE FROM GERM DISEASES.

The warrior cells may be overcome by a too numerous or too poisonous an enemy, or they may be more or less exhausted by a long conflict with one kind of an enemy and be unable to resist successfully a new one when introduced. People in malarial districts are more subject to the fatal ravages of cholera than those from more healthful localities. It is always wise to keep an army in the best possible fighting trim when facing a deadly foe.

When a ship, laden with a share of all the precious things of this world, is attacked by a band of pirates, the captain knows full well that the safety of his cargo, crew, and himself, depends upon the energy and strength of his fighting men. We would not form a very high opinion of his abilities if, under such circumstances, he were to fill the air which his faithful men had to breathe with noxious gases and the drinking water with stupefying and deadly poisons. The tobacco and alcohol user may be able to get a few grains of comfort out of the above figure!

If a large number of a certain kind of microbes be placed under the skin of a guinea pig an abcess will be formed in about twenty-four hours. A careful microscopic examination will reveal the fact that the contents of the abcess is largely composed of white corpuscles which are well filled with microbes, and that the microbes have not been allowed to spread over the entire body, thereby destroying the life of the animal. But if the guinea pig be stupefied with chloral, alcohol, or some other narcotic poison, after the microbes have been placed under the skin, the result will be quite different. In the latter case the white corpuscles will be made unfit for active service, the microbes will increase, and death will be the result.

If two small pieces of sponge be filled with disease germs and each one be placed under the skin of a healthy guinea pig and one animal be kept in a stupefied condition with chloral, alcohol, or something similar, this will be the result. The stupefied animal will soon die, and every part of its body will be filled with myriads of microbes, while the piece of sponge will be nearly as clear as when placed under the skin. The other animal will not show signs of sickness but the piece of sponge will be filled and covered with "matter," which the microscope will show to be an in-

numerable host of white corpuscles, more or less filled with microbes.

Recent investigators have discovered another startling fact regarding the white corpuscles. Alcohol, and other narcotic poisons, not only stupefy the corpuscles and render them unfit for service, but act in such a manner on the nerves and blood-vessels as to prevent their searching the tissues in pursuit of the lurking enemy. That is, the alcohol acts as a key to lock the fort while the invading army destroys the surrounding country.

It is also the office of the white corpuscles to eat, and thus destroy, particles of waste



Fig 11.—White corpuscles eating fragments of broken-down tissues.

matter which may be found in the blood, such as parts of the red corpuscles which have gone to pieces. When a tadpole is changing into a frog, the white corpuscles accumulate in the tail,

consume it and afterwards build themselves into the new structure of the frog. This gives us something of an idea of the importance of the work they are commissioned to carry forward within our own bodies.

It is estimated that during a prolonged debauch the alcohol destroys at least 100,000,-

000,000 of the red corpuscles, the fragments of which must be picked up and devoured by the white corpuscles.

Over twenty years ago the celebrated Russian experimenter, J. Dogiel, said that alcohol rapidly causes the amœba-like movements of the white corpuscles to cease, and that at a certain concentration it dissolves both the red and white corpuscles. Thus alcohol not only makes the white corpuscles unfit for efficient work, by depriving them of a proper amount of oxygen, food, and water, and making them stupid, but very greatly increases the amount of work to be done by them.

The foregoing statements make it very plain that the white corpuscles are a very important factor in our earthly existence, and that the use of alcohol (and tobacco) must greatly increase the amount of sickness and death from germ diseases.

In epidemics of germ diseases, such as cholera and yellow fever, the average death rate is about ten times greater among the habitual users of alcohol than among total abstainers. The use of alcohol and tobacco adds each year several hundreds of thousands to the total of the world's mortality.

RECAPITULATION.

Each person has from twelve to eighteen

pints of blood, which is the provider and purifier of the whole body. In this amount there are about 25,000,000,000,000 of red, and 80,000,000,000 of white corpuscles. The red corpuscles are coin-shaped and carry oxygen from the lungs to all parts of the body, where it unites with the prepared food, supplying heat and vitality.

The white corpuscles are somewhat larger than the red, can assume a great variety of forms, and move about independently like some of the one-celled animals. Their life work is to destroy the disease germs and other microbes which are constantly being introduced into our bodies.

Anything which interferes with the vitality and activity of either the red or white corpuscles increases sickness and the death-rate. Alcohol and other narcotic poisons make the white corpuscles less active, thus allowing the disease germs to increase, adding greatly to the sum of the world's mortality.

CHAPTER III.

THE CONQUEROR OF HEARTS AND HANDS.

The lowest forms of plants and animals, such as microbes, are composed of a substance called protoplasm. Life is always associated with protoplasm, which is sometimes spoken of as the "fundamental basis of life." Each speck of protoplasm, as in the case of microbes, can feel, move, grow (by taking food), and reproduce its kind. Each individual speck is called a cell, which means a portion of matter, not an inclosed hollow space as one of the air-cells of the lungs. Every living being begins its existence as a single cell—the lower forms never getting beyond that state. In the higher forms of life, such as man, the body is composed of an innumerable host of cells, more or less modified for special purposes. Whatever the cell is ordered to do, whether it be in the process of

feeling, seeing, hearing, secreting, excreting, or anything else, it does that one thing over and over again until it becomes an expert or specialist.

Habit is only a manifestation of the degree to which the cells of our bodies have been trained in certain directions.

All movements are produced by contraction of protoplasm. A muscle is a mass of this



substance set apart for a special use. Each muscle is made up of a very large number of minute fibers, and each of these of numerous cells of modified protoplasm, placed in a row. In appearance, a single fibre very much resembles a string of beads. If there are twenty thousand cells in a fiber and each cell contracts one-twenty-thousandth of an inch, the fiber will be shortened

Fig. 12.—Muscle fibre showing cell structure. Greatly enlarged

one inch. *All muscular movement is produced by the contraction of modified cells of protoplasm.*

But the muscle-cells will not contract unless stimulated to do so by the nervous system, numerous small fibers of which extend into every muscle. The muscles are servants and are ordered to move by the brain or some other nerve center,

The order is sent from the brain along the minute nerve fibers, very much as a telegram is sent from place to place along the wires. ANYTHING WHICH LESSENS THE POWER OF THE BRAIN TO SEND ITS STIMULATING INFLUENCES TO THE MUSCLE CELLS, OR LESSENS THE ABILITY OF THE CELLS TO RESPOND READILY, WILL LESSEN THE STRENGTH OF THE MUSCLE. That is, anything which makes protoplasm less sensitive or less active will weaken the nervous system and lessen muscular power.

During the past twenty-five years, there have been thousands of carefully conducted experiments proving, beyond a doubt, that small quantities of alcohol lessen the movements of protoplasm, while larger quantities destroy these movements. While this underlying fact is universally admitted, yet there are very many who still believe that alcohol stimulates the muscles to greater activity. This belief is still held, despite the well-known fact that muscles move only as they are acted upon by the nerves, and that alcohol lessens nerve activity. Before chloroform came into use alcohol was given the patient in order to deaden the nervous system and thus lessen the pain in surgical operations.

It is now often held in the mouth to relieve the toothache. Alcohol may produce such an inflammation in the stomach that drops

of blood ooze on the lining membrane, and yet no pain be felt. When people are under the influence of alcohol they do not suffer as much from the extremes of heat or cold as do others. Many freeze to death without knowing that they are cold. Hundreds of facts, like the foregoing, confirm the value of the scientific experiments, and prove conclusively that alcohol does lessen the activity of the nervous system.

Very many experiments, carefully conducted with the most approved and precise instruments, prove that alcohol weakens every muscle in the body. Those who are training for such physical contests as prize-fighting, rowing, and ball-playing, are strictly forbidden the use of alcohol. Thousands of trials have fully proved that men can do more work and endure more heat, cold, fatigue, or other hardships, without the use of alcohol than with it. A person may become a dangerous raving maniac by intoxication, but he will not acquire any degree of new strength.

He is not stimulated,—he has simply deranged the nerve centers of his brain. Any healthy temperate person who doubts these statements can verify them by making the acquaintance of lifting scales and a bottle of whiskey. Common observation will prove that the statement of scientific facts already

made is true, viz.—that alcohol lessens that property of protoplasm known as sensation, thereby retarding the action of the nervous system and the muscle cells, and results in weakening muscular power. No educated person, after having had his attention called to the matter, will, for a moment, doubt the truth of these conclusions.

The next step in this research is not so easily taken. IF ALCOHOL WEAKENS MUSCULAR ACTION IT MUST WEAKEN THE HEART'S ACTION, BECAUSE THE HEART IS A MUSCLE. Before the days of careful scientific investigation with accurate instruments, it was universally believed that alcohol was a stimulant. Even in recent years it is generally accepted as a settled fact and has been incorporated into nearly all medical and scientific literature. Accurate knowledge of the physiological effects of alcohol has, until of late, been neglected in the general forward movement in medical science from a lack of careful scientific experiment and investigation.

The writer began a series of experiments along this line in 1874, while an assistant of Dr. C. A. Kelsey, and has probably performed more experiments, in order to ascertain the effects of alcohol upon the healthy human heart, than has any other person. During these twenty years of observation and experi-

ment, not a single instance has been found where alcohol has proved itself to be a stimulant to the heart, in regard to either the strength or frequency of its contraction.

The force of the heart's contraction is studied by using a very delicately constructed instrument called the sphygmograph, or pulse-writer. A part of this instrument consists of a small pad, which is pressed gently upon the pulse artery by means of a spring. As the pad rises and falls, with each beat of the pulse, the motion is communicated to a small cross-bar, which is oscillated by a standard attached to the top of the pad. To the cross-bar is attached a long marker.

Every movement of the pulse is thus correctly reproduced, in a magnified form, by the end of the marker.

The frontispiece shows how the records are made. That part of the instrument which has been partially described is represented in the lower right hand corner of the engraving. It is attached to the wrist of the person who is being experimented upon. The marker extends to a cylinder, covered with paper, which has been blackened by burning camphor. The cylinder is slowly revolved by turning a crank, which makes twenty-seven revolutions while the cylinder makes one. The exact form of the pulse is thus outlined in the soot

on the cylinder, the height of the elevations indicating the comparative strength of the heart's contractions. When the sooty paper has been covered with traces, it is very carefully removed from the cylinder and dipped in a saturated solution of white shellac in alcohol, making a permanent record. Sections of a few of the many papers thus prepared are given. These experiments were performed upon healthy and strictly temperate people, and give a fair idea of the average results of all. The traces were taken every fifteen minutes, while the person was seated and quiet in every respect. All necessary precautions were taken regarding mental conditions and all outside influences.

Pure alcohol (95% by volume) was used in all the experiments, for it is almost impossible to procure any other kind of unadulterated liquor. All pure liquors are practically nothing more or less than alcohol and water mixed in different proportions.

The traces given below were selected, from the large number taken, to give a fair average of results in relation to age, sex, weight, variations in natural pulse rate, amount of alcohol given, manner of giving it, and the time after meals when the observations were taken.

Fig. 13 represents the pulse of B. H. B., age

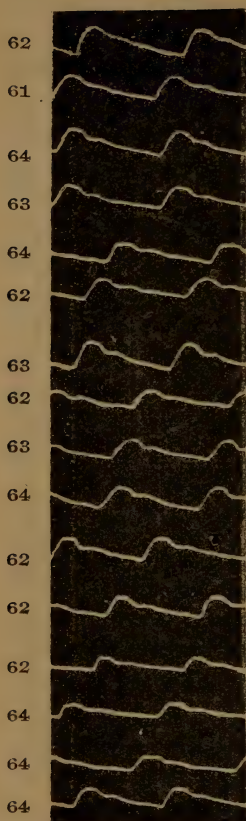


Fig. 13.

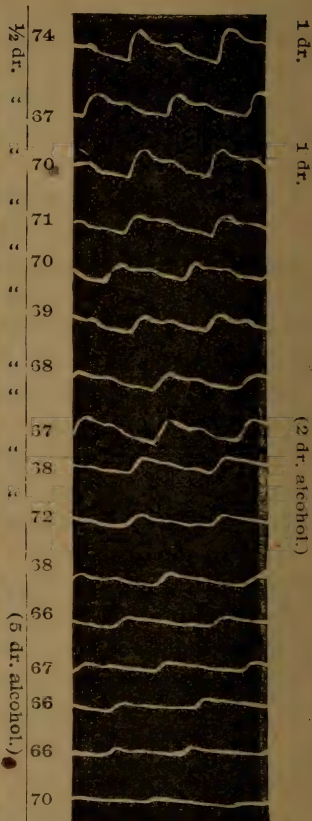


Fig. 14.

60, weight 150. Experiment began about one and a half hours after breakfast, a trace being taken every fifteen minutes. Immedi-

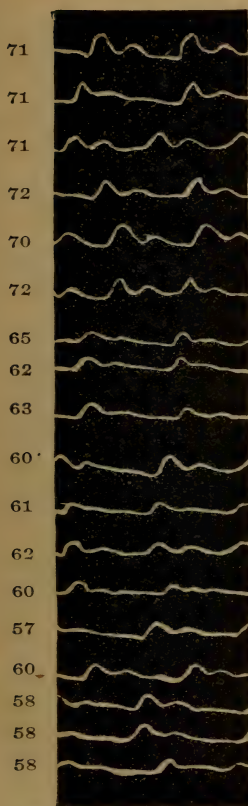


Fig. 15.

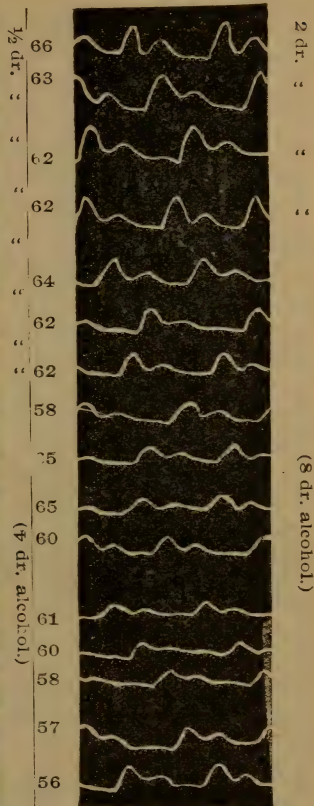


Fig. 16.

ately after taking each of the first ten traces, a half drachm of alcohol (equal to a teaspoonful of whiskey) was given—five drachms in

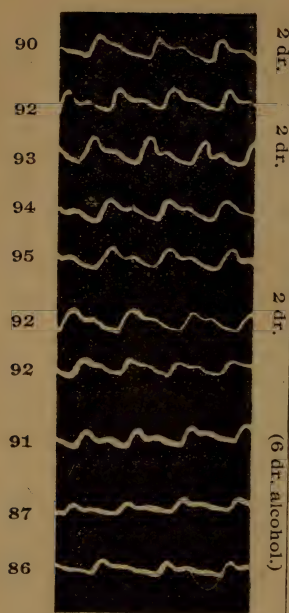


Fig. 17.

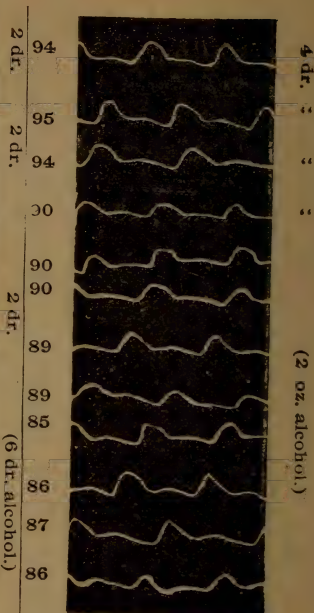


Fig. 18.

all. The pulse was carefully counted each time a trace was taken. The pulse rates were: 62, 61, 64, 63, 64, 62, 63, 62, 63, 64, 62, 62, 62, 64, 64, 64.

Fig. 14 represents the pulse of Miss D. B., age 21, weight 100. Experiment began one and three-fourths hours after dinner. Traces taken every fifteen minutes. One drachm of alcohol was given after taking the first and third traces, two drachms in all. The rates

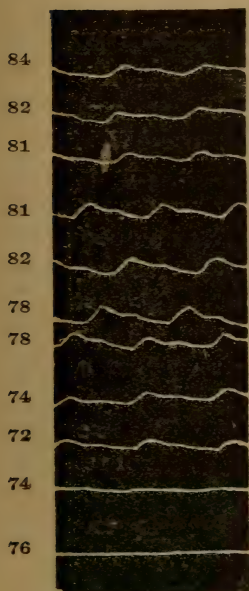


Fig. 19.

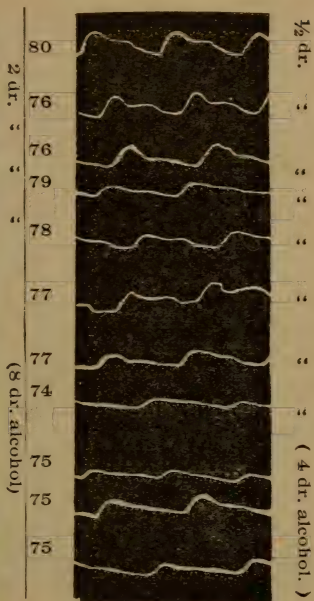


Fig. 20.

of the pulse when the traces were taken were: 74, 67, 70, 71, 70, 69, 68, 67, 68, 72, 68, 66, 67, 66, 66, 70.

Fig. 15 represents the pulse of G. E. R., age 23, weight 180. Experiment began one-half hour after dinner. A trace was taken each fifteen minutes. After each of the first eight traces was taken, one-half drachm of alcohol was given, four drachms in all. Pulse rates

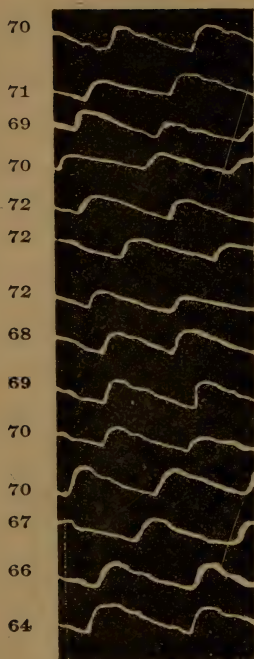


Fig. 21.

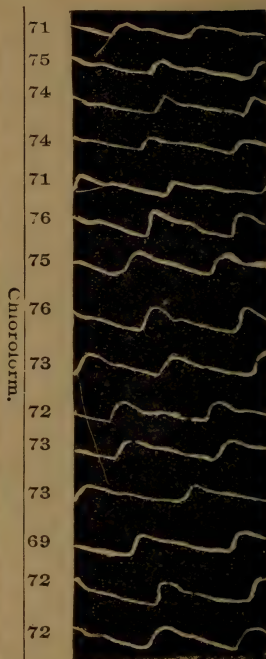


Fig. 22.

were: 71, 71, 71, 72, 70, 72, 65, 62, 63, 60, 61, 62, 60, 57, 60, 58, 58, 58.

Fig. 16 also represents the pulse of G. E. R. Experiment began one and one-half hours after dinner. Traces taken fifteen minutes apart. After each of the first four traces was taken two drachms of alcohol were given—eight drachms in all. Pulse rates were: 66,

63, 62, 62, 64, 62, 62, 58, 65, 65, 60, 61, 60, 58, 57, 56.

Fig. 17 represents the pulse of J. M. A., age 27, weight 120. Experiment began one and one-half hours after supper. Fifteen minutes between traces. Gave two drachms alcohol after the first, third, and sixth traces were taken—six drachms in all. The pulse rates were: 90, 92, 93, 94, 95, 92, 92, 91, 87, 86.

Fig. 18 represents the pulse of H. E., age 18, weight 140. Experiment began two and one-half hours after dinner. A trace taken each quarter of an hour. Gave four drachms of alcohol after each of the first four traces was taken—sixteen drachms, or two ounces, in all. The pulse rates were: 94, 95, 94, 90, 90, 90, 89, 89, 85, 86, 87, 86.

Fig. 19 represents the pulse of H. F. C. age 26, weight 155. He was in the habit of smoking three or four cigars each day. A strong cup of coffee was taken with dinner at 12 o'clock. Between 1 and 1:30, smoked a cigar. Experiment began at 3. Fifteen minutes between traces. Took two drachms of alcohol after each of first four traces, eight drachms in all. The pulse rates were: 84, 82, 81, 81, 82, 78, 78, 74, 72, 74, 76.

In this case the heart was much weakened by the tobacco habit. At first the alcohol partially revived the "tobacco heart," then

added its own paralyzing effects to that of the tobacco, making the man almost pulseless, although he *felt* better and stronger.

Fig. 20 represents the pulse of the same person, six days later. During the six days he abstained from the use of tobacco and tea and coffee. The experiment began two and one-half hours after dinner. One-half drachm of alcohol was taken after each of the first eight traces was made—four drachms in all. The pulse rates were: 80, 76, 76, 79, 78, 77, 77, 74, 75, 75, 75.

This set of traces and Figs. 13, 15, and 16, show something regarding the length of time required for the heart to begin to rally from the depressing effects of alcohol, when taken in small doses by healthy temperate people.

Fig. 21 represents the pulse of I. H., age 46, weight 135, under the influence of chloroform. The traces were taken every two minutes. He began inhaling the chloroform after the first trace was taken, continuing for twenty-three minutes. At no time was there total unconsciousness. The pulse rates were: 70, 71, 69, 70, 72, 72, 72, 68, 69, 70, 70, 67, 66, 64. Is chloroform a more powerful heart depressant than alcohol?

Fig. 22 represents the natural pulse of I. H. O. The experiment began immediately after a

ERRATA.

The sentence on this page, commencing in the 16th line from from the top, should read:

Twenty series of records (taken in order without omission) from these experiments give an average fall of six beats per minute in two and a half hours, beginning one and a half hours after meals.

light dinner, at which neither meat, tea, coffee, nor condiments were taken. Traces taken fifteen minutes apart. The pulse rates were: 71, 75, 74, 74, 71, 76, 75, 76, 73, 72, 73, 73, 69, 72, 72. This set of traces is about an average of many series of experiments made to ascertain the natural rise and fall in the force of the pulse. The depressions in the force of the pulse, (which indicates the strength of the heart), as shown by the preceding sets of traces, are not due to natural causes.

The experiments given demonstrate that alcohol is not a stimulant, at least so far as the force of the heart is concerned. The rates of the pulse given seem also to be affected by the alcohol. Twenty series of records (taken order without omission) from these experiments give an average fall of six beats per minute in two and a half hours after meals. The average amount of alcohol given in each experiment was about five drachms. Twenty series of records of the natural pulse, for the same length of time and the same interval after meals, give an average fall of 3.65 beats per minute, or less than two-thirds as much decrease in the rate as when under the influence of small doses of alcohol.

For many years the world has generally accepted as final the results of a carefully conducted experiment by Drs. Parkes and

Wollowiz, of England, to ascertain the effects of alcohol upon the rate of the heart's action. This very important experiment was made upon a healthy man, 28 years old, weighing 136 lbs. His diet was the same in kind and amount during the experiment, meat being prohibited.

He was a habitual user of tea, coffee, and tobacco, besides being a persistent moderate beer drinker. His system was so accustomed to the influence of these narcotics, that eight ounces of pure alcohol given in one day, during the progress of the experiment, did not produce "narcotic symptoms." During the experiment the habitual use of alcoholic liquors was prohibited, but tea and coffee were allowed, also a daily allowance of one-half ounce of tobacco.

The pulse was counted eight times each day, 208 records in all. For a period of eight days no alcohol was given; in the next six days there was a daily allowance of from one to eight ounces of pure alcohol; during the next six days no alcohol was given; then for three days about three ounces of pure alcohol, in the form of brandy, were consumed each day; after which came a like period of no alcohol. The conclusions were, in part, that two ounces of pure alcohol (equal to a gill of brandy or whiskey) increased the heart's ac-

tion 8,172 beats per day, while eight ounces increased its action 25,000 beats. When the facts regarding the habitual and continued use of narcotics are taken into consideration, the absurdity of accepting the results of this experiment, as final, is apparent. Now, since much that has been believed, said, and written, for over twenty years, regarding the action of alcohol on the heart, has been based upon the published results of this experiment, the writer may be pardoned for presenting the results of his most extended series of experiments designed to verify the "celebrated Parke's experiment."

A perfectly healthy man was selected, age 46, height 5 ft. 9 in., weight 135 lbs., who had never used narcotics (or "stimulants") of any kind. He was a retired physician, of good physique, nervous temperament, but with digestive powers somewhat below the average. All necessary precautions were taken regarding diet, amount of fluids used, temperature of room and of food and drink, position of body, exercise, and state of mind. The pulse was carefully counted every fifteen minutes from rising to retiring, or sixty times each day, 1440 records in all. The diet consisted of bread and butter, oatmeal, cornmeal, granola, limited quantities of potato and fruit, and one pint of milk per day.

When alcohol was used between meals, it was well diluted with water; when taken with meals it was put into one-third of a pint of milk, all other fluids being prohibited, as well as meats and condiments. Each meal occupied the time between two counts. The records began each day at 7:30 a.m., three being made before breakfast, eighteen between breakfast and dinner, twenty-two between dinner and supper, and seventeen between supper and the time of retiring, 10:15 p.m. The experiment extended over twenty-four days, divided into eight periods of three days each. During the first period, no alcohol was given. One ounce of pure alcohol (95% by volume) was given the first day of the second period, two ounces the second day, and three ounces on the third. The third, fifth, and seventh periods were like the first, and the fourth, sixth, and eighth were like the second. The 720 records made during the twelve no-alcohol days gave an average of 66.48 heart beats per minute. The same number made during the twelve alcohol days gave an average of 65.52 heart beats per minute, that is, the heart beats at the rate of 1382.4 times per day less than natural when an average of two ounces of pure alcohol was given daily. The alcohol was given between 8 a. m. and 6.15 p.m., in doses

varying from one-half drachm to an ounce, two thirds of the time it being given in three equal doses with meals. It should be remembered that brandy, whiskey, gin, and rum, are about one-half, wines about one-fifth, cider about one-fourteenth, and beer about one-twentieth, alcohol, this being the active principal in all these fluids.

When three ounces of alcohol were given, in drachm doses every fifteen minutes, there were marked "narcotic symptoms." In fact, there was an advanced stage of intoxication which caused the man to stagger about the room, and made it difficult for him to feed himself. The intoxication was well marked when an ounce had been taken in this manner; but when the ounce was taken with a meal, there was but slight intoxication, and that would usually disappear in about thirty minutes. About fifteen minutes after a meal, when one ounce had been taken, the man would appear dizzy and bewildered, would stretch out his arms and clinch his hands, much as a person sometimes does when awaking from the effects of chloroform. When three ounces per day were given, there was a disturbance of digestion, followed by tenderness in the region of the stomach, indicating that the alcohol had produced more or less inflammation.

This irritation of the stomach, and the probably prolonged period of digestion, seemed to be the principal causes which tended to increase the heart's action when the larger doses were given. That is, alcohol does not increase the daily average of the pulse rate until enough is taken to produce local inflammation and a general disturbance of the system. The average of the eight days, when the allowance averaged one and one-half ounces per day, was 64.87 beats per minute or 2318.4 *fewer* beats per day than the normal rate. The average of the four days, when three ounces were given daily, was 66.83 beats per minute or 504 *more* than the normal daily rate. This higher rate is not due to stimulation, but to the fact that the pulse rate did not fall as low before dinner, supper, and bed time, as it did when the smaller doses were given. If we compare the 'one ounce days' with the 'three ounce days' in the chart of pulse rates, we are led to inquire whether the difference is not due to an irritated stomach and a retarded digestion.

It would have been very interesting and profitable to have given this rare and valuable subject, for such an experiment, larger doses, but it was not considered entirely safe to do so. It is not safe for adults who are not habitual users of narcotics, (including tea

and coffee), to take eight ounces of alcohol in one day. If that quantity should be taken at one dose, fatal results would often quickly follow.

The results of the above experiment agree with the records of many similar ones taken for the same purpose. The only conclusions that can be drawn from twenty years of experiment and observation are, that alcoholic liquors of all kinds and in all sized doses, usually depress the action of the heart both in force and in rate. There is no period of stimulation or excitement.

The depression in force usually begins in about twenty minutes and lasts two or more hours, while the rate is usually but slightly affected. Much material is at hand from which these conclusions are drawn. Those who have never conducted such a series of experiments are scarcely able to comprehend the amount of expense, time, patience, and care necessary, in order to get sufficient data for anything like correct conclusions. The chart of pulse rates will be found very interesting and valuable. Each square represents fifteen minutes, horizontally, and an increase or decrease of one pulse beat per minute, vertically. The continuous irregular lines represent the average of twelve no-alcohol days, each beginning with sixty-two

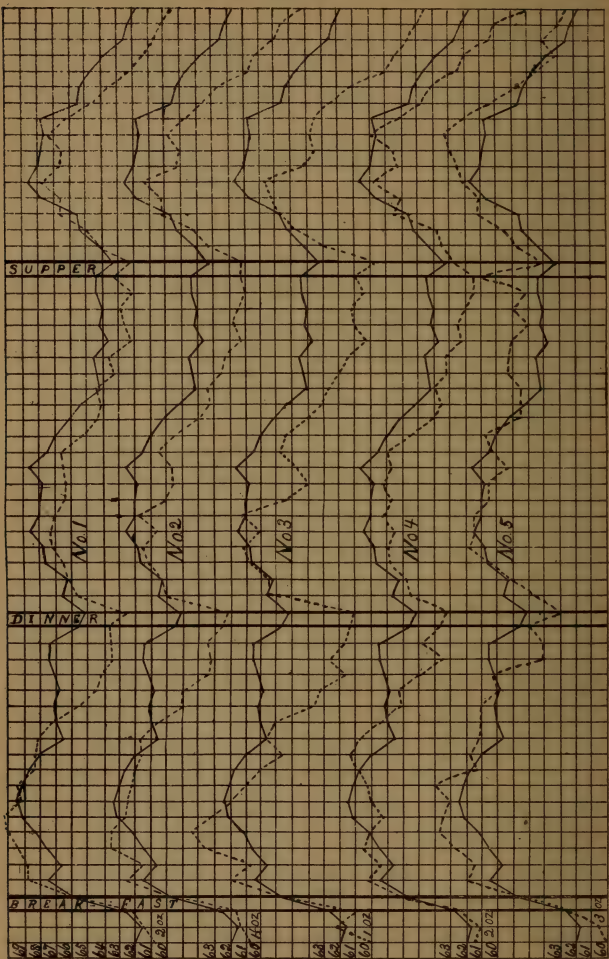


Fig. 23.—Chart of Pulse Rate.

The first dotted line (at the top) represents the average of twelve alcohol days when an average of two ounces per day was given. No. 2, the average of eight days for an average of one and one-half ounces; No. 3, four days, for one ounce; No. 4, four days, for two ounces; and No. 5, four days, for the three ounces per day.

The thoughtful and observing person will find much of value and interest in the pulse chart. The inquisitive one will soon discover that it was necessary to make over eight hundred points when "laying off" the chart, and that the straight-edge occupied over six hundred positions in the drawing of it. The economical person will observe that it represents over one hundred dollars in time and money; and the curious will be delighted to know that there is nothing else on earth just like it.

The reader will bear in mind that all these experiments were made for the purpose of ascertaining the effect of alcohol on the healthy human heart. The writer is not aware of any carefully and wisely conducted experiment that has ever been made, that does not, in the main, agree with the result just recorded. H. N. Martin, A. M., M. D., D. Sc., professor in Johns Hopkins University, and one of the noted experimenters in America, has

done much praiseworthy experimenting in order to determine the effect of alcohol on the action of a dog's heart when separated from all parts of the body except the lungs. In these careful tests, the heart was first furnished with pure blood, then with blood containing a certain per cent of alcohol, afterwards with pure blood again. If the heart in any case did not revive when furnished with pure blood, *after* it had been depressed by alcohol, that experiment was rejected, fearing that the depression was due to failing vitality. But when the heart revived under the influence of pure blood, it was considered certain that the depression was caused by the alcohol. Dr. Martin states the results of his noted experiments, as follows:—"Blood containing one-eighth per cent of alcohol has no immediate perceptible action on the isolated heart. Blood containing one-fourth per cent, by volume, almost invariably remarkably diminishes, within a minute, the work done by the heart. Blood containing one-half per cent, that is, five parts in a thousand, always diminishes and may even bring the amount pumped out of the left ventricle to so small a quantity that it is not sufficient to supply coronary arteries."

An ordinary drink of whiskey or brandy will give more than the one-fourth per cent,

or one part in four hundred of pure alcohol in the blood of an average man, which "*almost invariably remarkably diminished within a minute the work done by the heart.*"

These experiments, and hundreds of others, bearing directly or indirectly upon the same subject, which have been made upon the lower animals, by some of the best scientists in the world, all proclaim that alcohol lessens the sensibility and motive power of protoplasm and, therefore, not only lessens the ability of the nervous system to send stimulating influences to the muscles, but lessens the ability of the muscles to respond to the influences sent to them. ALCOHOL IS NOT A STIMULANT. Thousands of fatal cases of stimulation (?) annually attest to the truthfulness of this statement. Alcohol, as found in all kinds of alcoholic liquors, is the great conqueror not only of hearts and hands, but of bodies and souls.

CHAPTER IV.

THE FIRST GRIST MILLS RUN BY WATER.

Man is said to be a stomach with such appliances as feet, hands, and head, to keep it supplied with material to be ground. This process of reducing food to a condition fitted to make bone, muscle, and brain, is carried on largely by water. In fact every movement of our bodies, even to the assistance in the production of thought, is possible only by the aid of water. If our brains and other organs did not contain a large amount of water, they would be of no more use than ordinary leather. Water is the only fluid that can dissolve the various articles of food which are taken into our stomachs. The blood is fluid and is rendered capable of conveying the digested food to every tissue and cell of the body, because it contains a large proportion of water. It is water which takes up the waste products from the wear and tear of the tissues, and conveys them out of

the body by a most complicated and wonderful sewerage system. Water gives form, size, flexibility, and capacity for motion, to the different parts and organs of our bodies. The chewing and swallowing of solid food is made possible because of its being mixed with the saliva, which is 99 per cent water. The saliva moistens, and partially digests, the food. When the food reaches the stomach it is mixed with large quantities of gastric juice, 97 per cent of which is water. The other three fluids, poured into the digestive organs beyond the stomach, are from 87 to 90 per cent water. The food, thus prepared by these very watery fluids to become a part of the living tissues, is taken up and carried to every hungry cell in the body by the blood, which is, itself, 79 per cent water. The muscles, which contract with so much power, are 74 per cent water, and the brain—the organ of the mind—contains no less than 79 or 80 per cent of this all-important and ever-present fluid. A constant supply of water is so necessary that great suffering results if it be withheld for even a few hours, and death would follow in less than a week. Insane persons who have taken nothing but water have been known to survive for two months. Most articles of food, as prepared for the table, are more than half water.

On an average, it is necessary to add, each day, about one pint of water to the amount taken as food, in order to supply the demands of the system. Thirst, in the healthy person, is the crying out of the cells of the body for the water needed for carrying on the proper work of the various tissues. *No other fluid will in any manner, or to any degree, supply this imperative demand.*

When a drink, which contains a fluid that has such an affinity for water, that this fluid will rob the cells of water already contained, is introduced into the system, thirst is increased, because water has been drawn from the tissues instead of being supplied to them as demanded. A person who may be thirsty from excessive perspiration, caused by a hot bath, does not have the thirst relieved by increasing the amount of water in the bathtub. Neither is a cell or tissue, which has been robbed of a part of its water by a chemical agent, satisfied by any amount of water that may be hurried past, on its way out of the system, by the shortest possible route.

Alcohol has such an affinity for water that it seizes upon it whenever it can be found. If a piece of lean meat be put into alcohol it will become quite hard and shrunken by having water extracted. Mix the white of an egg with brandy and it will be "cooked," be-

cause the alcohol has taken so much of the water from it. Soft-bodied animals, when preserved in alcohol, are so dried and shrunk as to be useless for illustrations in teaching natural history. Alcohol that has already been mixed with large quantities of water, retains its ability to take more water from every possible source.

All kinds of alcoholic liquors are simply water mixed with a certain per cent of alcohol. Ten pints of beer are equal to one pint of whiskey or brandy put into nine pints of water, or one half pint of alcohol put into nine and one half pints of water. The man who pays one dollar per day for twenty-one half-pint drinks of beer usually objects to being called a "water drinker," although he has consumed nearly ten pints of that fluid, for which he has paid eighty cents. But even in such a case this large amount of water will not prevent the half pint of alcohol from so injuring the tissues, that there will be suffering from thirst as soon as the system is sufficiently recovered from the narcotic effects of the alcohol. The habitual use of beer, cider, or stronger liquors, increases thirst, and this can only be relieved by keeping the tissues so stupefied with alcohol that they are not able to cry out against the injuries already inflicted. When the thirst increases

faster than the alcohol can be supplied to quiet the demands of the tissues, it becomes all-absorbing and is called *dipsomania*, or drink madness.

When alcohol (in any alcoholic liquor) is swallowed, two principal effects on the mouth and throat are quite noticeable. More or less water is taken from the tissues, giving a sensation of thirst, and this is intensified as soon as the second or deadening effect has ceased. This stupefying effect causes the little muscles, which surround the minute blood-vessels, and regulate the supply of blood to any given part, to relax their hold on the vessels, and this allows an increased flow of blood to the mucous membrane. The unusual amount of warm blood around the nerves of feeling in the mucous membrane gives a sensation of increased warmth. This sensation, and the increased redness, are known as the irritating effects of alcohol.

When alcohol reaches the stomach, where it must remain for some time in contact with the tissues, the effects are more marked. If the alcohol is well diluted, as in beer, the redness or blush from taking the first dose will soon pass away. If its use is continued the redness becomes permanent, for the little muscles lose their power over the blood-vessels. The continued congestion and irritated condi-

tion causes the lining membrane to thicken at first and then to slough off in patches, thereby producing ulcers. When average quantities of beer and cider are the only liquors used, the stomach is not apt to ulcerate, but is usually more or less enlarged. *No person can habitually use average quantities of any kind of alcoholic liquor and have a perfectly healthy stomach.*

Every tissue, and every fluid of the whole body, is able to carry on the work necessary to make life and health possible, only when it contains a certain amount of water. So is it with other useful articles. Dried ink is as useless as is ink that has been flooded with water. When a person drinks alcoholic liquors, the alcohol extracts water from the various tissues and renders them more or less useless, until they have time to repair the injury, or to form the habit of doing the best they can under the abnormal circumstances. While the alcohol is working ruin by lessening the activity of the nerves and muscles and extracting water from the tissues and cells, the water, taken along with it, or to relieve the thirst caused by it, is making the fluids of the body more or less useless by diluting them. This is especially true so far as the digestive fluids of the mouth and stomach are concerned. The irritating effects

of alcohol cause an increased flow of these fluids, but of an inferior quality, and then the irritant proceeds to separate the active part, or ferment, from the water in these aids to digestion, rendering them entirely useless. From this, it is plain that digestion cannot be carried on in the stomach while any considerable quantity of alcohol is present. Before the digestive process can proceed, the diluted and useless fluids, including the alcohol, must be removed and new fluids secreted and poured into the stomach. When a moderate quantity of alcohol is taken several times each hour after a meal, the food will not even begin to digest. In such cases, the food, together with quantities of ropy mucous, is sometimes vomited up ten or even twenty hours after the meal. If the quantity of alcohol drunk is large, as in a drunken debauch, the digestion is not only stopped, but the stomach refuses to remove the alcohol, as fast as it is received; so alcohol may be ejected, with the undigested food, after the individual has lain in a drunken stupor for ten or more hours.

The large quantities of mucous poured into the stomach, under such circumstances, seems to be a wise provision of nature to dilute and surround the poison and keep it away from the delicate tissues, where it might excite

fatal inflammation. It also serves to prevent the poison from too rapidly escaping into the blood, where it would certainly produce fatal results.

Alcoholic liquors of every kind and name can never, under any possible condition, be of use to a healthy stomach or to its healthy owner. In the very rare cases where alcoholic liquors can be prescribed with benefit to a diseased stomach, or to its diseased owner, other more useful and less injurious remedies can be prescribed with more benefit.

CHAPTER V.

THE SUGAR FACTORY.

It is necessary that a large part of our bread, and of nearly all other vegetable foods (the starchy portions), shall be changed into sugar in the process of digestion. All the sugar that has been made from the starch in the food, together with all other foods and fluids, (except fats), are caught up by the minute blood vessels of the stomach and intestines, carried to the portal vein, and hurried on to the liver.

The liver is the largest and most important gland in the body. It is divided into about 2,000,000 sections or "rooms" (lobules). In each "room" there are about 125,000 skilled workers—cells of modified protoplasm—who toil day and night that the population of the entire system may be supplied with properly prepared food. When the portal vein enters the liver it divides and subdivides until the veins are only $\frac{1}{1200}$ th of an inch in diameter.

These little veins run over and around the "rooms," or lobules, in every direction, branching off, finally, into capillary blood-vessels, which are only $\frac{1}{3000}$ th of an inch in diameter. Large numbers of these capillaries pass into each "room" and thus bring the blood, containing the food and drink just received from the stomach and intestines, into close contact with each of the 250,000,000,000 workers, or liver-cells. Each "room" is supplied with sewer pipes, serving as outlets into the hepatic duct. This duct conveys the large quantities of material, which have been extracted from the blood, while passing through the liver, into a convenient reservoir called the gall-bladder.

The three principal functions of the liver are, (a) to refine or remanufacture the sugar received from the organs of digestion; (b) to produce large quantities of another kind of sugar; and (c) to manufacture or excrete the bile. Upon the proper performance of these functions of this organ, depend the happiness, health, and life of the individual. The food must be properly prepared by the liver, else it will not nourish the tissues—leaving the individual to die of slow starvation, regardless of the amount or kind of food taken. When the blood contains too much bile, we have that peculiar and danger-

ous disease called jaundice. While it is necessary to keep the blood free from bile, yet the bile is a necessary factor in completing the process of digestion, being poured into the intestines from the gall-bladder, just below the stomach. If all this work is carried on by the great "sugar factory," and if health and life depend upon the amount and quality of work done, it seems wise and proper that we should manifest an intelligent interest in the welfare of the two hundred and fifty billions of little toilers who strive so faithfully, day and night, to do so much and to do it so well.

We have learned that alcohol destroys the gastric juice of the stomach, and may, in time, destroy the stomach itself, thus interfering very much with the preparation of the food, which is on its way to become a part of the body. Under no circumstances do the digestive fluids change the alcohol, for it is not capable of being digested. It is taken up by the blood-vessels in an unchanged state, and carried to the liver with the selected food and water. When it reaches the liver its effects are very much like those produced when it first comes into contact with the tissues of the mouth—it lessens the activity of the protoplasm in its whole structure. This results in an enlargement of the liver, caused by hold-

ing a larger amount of blood in the vessels, and saturating the tissues around them with the water which escapes from the vessels. The stupefying of the liver cells, and the change in the condition of the whole organ, interferes with its important work in preparing the food for the nourishment of all the tissues of the body, and in taking the bile out of the blood for its necessary office in the process of digestion. Of course this defective work leads to a derangement of the whole system, as is manifest in a disturbance of digestion, a coated tongue, foul breath, headache, dizziness, languor, "the blues," and general unpleasant sensations of both body and mind.

All consciousness of the general disturbance and ruin, which have been wrought by this evil spirit, may be temporarily banished, if enough more of the same article be taken to quiet the brain and nerves. This leads the victim to believe that he is better, and, by degrees, he becomes a confirmed drunkard.

The late Dr. Palmer, of the University of Michigan, when speaking of the chronic effects of alcohol on the liver, says: "Much more serious effects are, in some cases, produced by alcoholics, and beer is more apt to act in the way about to be mentioned than whiskey. An accumulation of fat is often

produced in the liver, causing its greater and more permanent enlargement, and impairing more permanently its action. When this is the case stopping the use of the drink does not produce the same rapid improvement as in the cases before mentioned. But where the fat is deposited between the proper liver cells or structures, without taking the place of them, abstaining from drinking may, in time, be followed by much improvement.

There is another fatty change, much worse than this, where particles of fat take the place of the structure. This is called fatty degeneration, and when it occurs other organs are likely to be affected in a similar way; and this disease before a great while ends in death.

When any portion of the liver is changed into fat, that part cannot do its work, and as the change goes on, action will cease, and death must follow.

* * *

I will here only say that there is a disease of the liver called *Cirrhosis*, from its yellow color, and *hob-nail* liver, from there being upon its surface rounded projections, looking like the large nails on the soles of an English laborer's shoes; and this disease is also called *gin-liver*, from its always being produced by drinking strong liquor. The liver, though swollen at first, becomes shriveled and much smaller later, and all through it are small

masses, causing the inside to look like a cake of beeswax in which, when it was melted, yellow peas had been mixed.

In this condition the blood cannot properly circulate through it, it cannot perform its proper functions, dropsy follows; and when the disease is established, death always occurs in a few months, or at the longest in a very few years. As with certain alcoholic diseases of the stomach, particularly cirrhosis and contraction of its walls, even the abandonment of the alcohol comes too late.

This Cirrhosis, as well as other structural alcoholic diseases, is more likely to occur from steady drinking, though it be not carried to the extent of positive drunkenness, than from occasional debauches, however excessive, and however morally and socially degrading and disastrous. These structural changes of the liver, from the effects of alcohol, though sufficiently common to be very familiar to physicians, are not nearly so frequent as the derangements of action of this important organ from the same cause, without distinguishable changes of its structure."

Dr. Hope, in his "Morbid Anatomy," speaking of a cab-driver's liver, said:—"The tubercles first appeared as individual *grains*, or points of disease, then they coalesced and finally formed large compact masses. The

liver is enormous—five times its natural size, crammed with thousands of tubera, varying from this size O to that of an egg.”

Dr. Richardson says: (‘Diseases of Modern Life’ p. 256-7-8), “The liver of the confirmed alcoholic is probably never free from the influence of the poison; it is too often saturated with it. * * The organ at first becomes enlarged from the distention of its vessels, the surcharge of fluid matter, and the thickening of tissue. After a time there follows contraction of membrane, and slow shrinking of the whole mass of the organ in its cellular parts. Then the shrunken, hardened, roughened mass is said to be “hob-nailed.” * * The body of him in whom it is developed is usually dropsical in its lower parts, owing to the obstruction offered to the returning blood by the veins, and death is certain.

* * Again, under an increase of fatty substance, the structure of the liver may be charged with fatty cells, and undergo what is technically designated fatty degeneration. I touch with the lightest hand upon these deteriorations, and I omit many others. My object is gained if I but impress the mind of the reader with the serious nature of the changes that, in this one organ, alone, follow an excessive use of alcohol.”

The writer has seen a drunkard’s liver

which had the general appearance of a mass of decomposing cheese, and when a single cut was made through it, there were revealed hundreds of "pockets" from the size of a pin head to that of a walnut, all filled with a soft purulent matter. These chronic diseases of the liver are nearly, or quite, painless, progress slowly, and give very little or no warning of their presence till long after all hope of recovery is past, even when the cause which produced them is discontinued. Too often it is a fatal error for a person to believe that he is not being injured by alcohol, simply because he does not suffer pain.

IT IS NOT POSSIBLE FOR ANY PERSON TO USE ANY KIND OF ALCOHOLIC LIQUORS HABITUALLY AND POSSESS A PERFECTLY HEALTHY LIVER.

CHAPTER VI.

THE HEATING PLANT.

The wind pipe passes from the throat down into the chest, where it divides into the two large bronchial tubes, one for each lung. These bronchial tubes divide and subdivide until they are too small to be seen without the aid of a microscope. At the end of the minute bronchial tubes are the air-cells, which are about $\frac{1}{100}$ th of an inch in diameter. The air-cells are not



Fig. 24.—Minute bronchial tubes terminating in air-cells. Greatly enlarged.

like the blood, muscle, nerve, or other body cells, or the microbes, which are one-celled plants or animals, for these are always little masses of protoplasm, more or less modified, and with or without a surrounding membrane; while the air-cells are hollow spaces surrounded by membranes which are only $\frac{1}{2400}$ th of an inch thick. However thin the membrane may ap-

pear to be, still it is more than five times thicker than a red corpuscle of the blood. Orton's Zoology states that there are in the lungs of each person 600,000,000 air-cells, and that the surrounding membranes of all these, if spread out, would cover 132 square feet, equal to eight or nine times the surface of the whole body.

The blood-vessels which enter the lungs from the heart, divide and subdivide until they become capillaries $\frac{1}{3000}$ th of an inch in diameter, with walls of almost inconceivable thinness. These minute blood-vessels pass over and between the air-cells in every direction, thus spreading out the blood in exceedingly thin layers almost in direct contact with the inhaled air which lies on the other side of the 132 square feet of membrane. Through this membrane passes the poisonous carbonic acid gas of the blood to be carried out of the lungs by the expired air. At the same time the oxygen of the air is passing inward through the same membrane to reach the red corpuscles, these having a great affinity for oxygen. Drowning results from the preventing of the interchange of these gases for a very few moments.

The air-cells are supplied with fresh air by the process of breathing. This is accomplished in the successive expansion and contraction

of the chest by the activity of a large number of muscles. We have already learned that alcohol lessens muscular power, therefore its use must lessen the amount of pure air supplied, by interfering with the act of breathing, making it less powerful and less frequent. A part of the alcohol taken into the system is thrown out by the lungs,—as shown by chemical tests and by the odor of alcohol in the breath,—thus making the smaller amount of inhaled air doubly impure while in the lungs. Also, the alcohol in the blood so changes it that it is unable to throw out, as it ought, the waste and poisonous matter. The amount of carbonic acid gas thrown out of the system through the lungs is said to be reduced one half in some cases.

The red coloring matter of the corpuscles has such an affinity for oxygen that it takes it from the air in the lungs, through the membranes of the air-cells. It is then distributed over the entire body, uniting in the meantime with the prepared food in the blood. The uniting of the oxygen with the food elements forms a true combustion, or burning, thus supplying the body with heat and vitality, making life and activity possible. Anything which interferes with the supply of air to the lungs or with the work of the red coloring matter of the 25,000,000,000,000 red corpuscles in securing their quota of oxygen, interferes with the very fountains of life.

Alcohol has such an affinity for the red coloring matter that it destroys very many of the corpuscles, when large quantities of it are introduced into the blood, and all are more or less injured. When small quantities are taken, the damage is proportionally less. When the amount of alcohol found in a full drink of beer, or a half drink of whiskey, gets into the blood, it lessens the quantity of oxygen consumed to such an extent that carefully conducted experiments will readily demonstrate and measure the difference. As the heat of the body is maintained by the union of oxygen with the digested food, it follows that anything which interferes with perfect digestion tends to lower the heat of the body. This is especially true regarding that special process and final digestive act, performed by the liver, which prepares the food to be burned by the oxygen. When we consider how alcohol acts upon the stomach, liver, lungs, and especially upon the red corpuscles, we can readily believe what the thermometer always tells us in such cases, although the external appearances seem to disprove it, viz.: *alcohol lowers the temperature of the body.*

When moderate doses of alcohol are taken, there is a partial paralysis of the muscles which control the supply of blood to the skin.

This results in an increased flow of blood to the surface of the body, giving the appearance of an increased temperature, and greater activity in the circulation.

The nerves of sensation, which report to the brain the changes in the temperature, are located near the surface of the skin and are accustomed to a certain degree of heat. When the hot blood rushes to the surface, the nerves report an increase of temperature, just as the nerves of the face do when a person blushes, although the general heat of the body may have been lowered.

When alcohol circulates in the blood, it not only injures the corpuscles, and every other part of the blood, but it also injures the delicate membranes of the air-cells as it passes over and through them. The skin is for the protection of the surface of the body, and is very tough and strong to resist all the wear and tear of a life time; but when alcohol is applied to it for the first time it produces congestion.

If applied to the same place for a number of times, the skin will become thickened and otherwise injured. When alcohol is constantly attacking the membranes of the air-cells, and other tissues which are not exposed and are so very delicate, it is reasonable to believe that

injury is done in every case, and that these injuries must, in time, prove fatal.

The large quantity of water taken with alcohol, or to quench the thirst caused by it, also works untold mischief in the blood, lungs, and other organs. The internal revenue statistics for the year 1893 show that the people of the United States consume annually over 100,000,000 gallons of spirits (whiskey, brandy, etc.) and over 1,000,000,000 gallons of beer, besides all the untold millions of gallons of wine and cider. The amount of pure alcohol in the beer and spirits consumed is about equal, 50,000,000 gallons in each, or 100,000,000 gallons of pure alcohol in both. If the amount of water added to the spirits by the retailer before it is sold, and by the consumer before and after drinking it, is equal to three times the bulk of the raw spirits, and if the untold quantities of artificial liquors, domestic beer, wine, and cider, and the product (with the water consumed with it) of thousands of illicit distilleries, equal the amount of pure alcohol in the beer and spirits, (and these are reasonable estimates,) then each of the fourteen million drinkers of all classes consumes, on the average, one hundred gallons of worse than useless water each year, to say nothing regarding the more than seven gallons

of pure alcohol which goes with it. If all the pure alcohol consumed were taken in the form of beer, it would give an average of 140 gallons of water per annum for each of the 14,000,000 drinkers. But, as nearly all the liquors are consumed by 6,000,000 habitual drinkers, the above averages must be at least doubled when applied to them. Many drinkers use five hundred gallons of beer per year, or twenty-five gallons of alcohol diluted with four hundred and seventy-five gallons of water. The average time required, in which to remove the surplus water so introduced into the blood with the alcohol, is fully one hour. During this hour, it passes through the lungs, and other parts of the body, thirty times, and through the heart sixty times. The average work of a healthy heart, during each minute, is to circulate about nine pints of blood over the entire body, using up enough muscular energy to raise over 300 pounds one foot high.

The beer drinker, who consumes six quarts per day, burdens his heart, already weakened by the alcohol, with the extra work of circulating over eleven pints of surplus water, while it is being removed from the blood. This extra task is equivalent to raising over 12,000 pounds—more than six tons—one foot high each day of his life.

The first effect of this extra work is to increase the size and strength of the heart to meet the extra demands, just as extra work increases the size and strength of the blacksmith's right arm. But there is a limit to the development of the heart and every other muscle. When this limit is reached, the work must be lessened or weakness, followed by exhaustion, will follow. A heart may be overworked as well as an arm. When the extra burdens are imposed, after the heart has reached the limit of proper development, it continues to increase in size, not by the growth of the muscles, but by the increase in the size of the cavities, thinning and weakening the muscular walls. The change in the size and power of the heart, together with the diseased condition of the muscular fibres, is liable to terminate the individual's life at any moment, although he may be the "picture of health" so far as external appearances are concerned. The excess of water taken with alcoholic liquors interferes with digestion; with the work of the liver; with that of the blood in supplying the tissues with proper nourishment; with the escape of carbonic acid gas and the taking in of the oxygen; and with every other function. Besides these interferences, the getting rid of it imposes great burdens upon the kidneys and other organs.

Anything which interferes with the growth of a child, with his usefulness during adult life, or with his burial after death, interferes with the best interests of society. Each cell of which the human body is composed, bears a similar relation to the whole number, as does each individual to society at large. The life history of each individual, in either case, is a matter of interest to all. But when the life history of a whole group is interfered with, by a common enemy, there comes an intense struggle for existence. Every cell of the body has its periods of growth, usefulness, decay, and death, and the consequent necessity of removal from its fellows. Anything which hastens the removal of the worn-out cells, and the growth of new ones to take their places, is of benefit to the living organism.

The more rapidly the cells are renewed, (within the limits prescribed by nature) the more vitality is manifested by the individual. Exercise not only aids in the removal of the worn-out cells and in the production of new ones, but it strengthens every organ and thus enables it to do more and better work: the stomach digests better; the liver does its work more perfectly; the heart sends the blood coursing through the arteries faster; the lungs take in more air; the blood is furnished with plenty of oxygen; the brain is stimulated; se-

cretion and excretion are more active; the white corpuscles destroy more disease germs; and the general welfare and happiness of the individual is thereby greatly increased.

When an arm is paralyzed and remains perfectly inactive, in the course of time, more or less of the muscle and nerve cells will be replaced by a fatty substance.

This substance is sometimes called "grave fat," because it appears so much like "adipocere" (wax fat), into which bodies that have been buried in marshes often change. Now, alcohol, by interfering with so many functions of the body, gradually brings about a condition similar to that which follows a lack of exercise. All the benefits, attributed to the proper amount of exercise, will be found wanting, and this is true, more especially, in regard to the proper removal of the worn-out and poisonous matter. The habitual use of even moderate quantities of alcohol will produce—probably in every case—in a limited number of years, more or less of "grave fat," or that condition of the tissues termed fatty degeneration. This has no reference to the accumulation of fat under the skin and elsewhere, but to a condition in which the cells are replaced by inert fatty particles instead of new and active body elements. This changing of the natural cells into

worse than useless fat, occurs in the heart, lungs, liver, kidneys, brain, muscles, and perhaps every other organ in the body. It is not uncommon for the muscles, and especially the liver, of the drunkard to be so changed to fat that a bright knife blade will be streaked with oil if passed through them. This condition develops so slowly and painlessly that it is not noticed until one or more of the organs fail to do their work perfectly, or until sudden death is caused by heart failure, the breaking of a blood-vessel, or the failure of some vital function.

Fatty degenerations of the different organs receive different names, according as the symptoms are more prominent, such as cirrhosis of the liver or kidneys, Bright's disease, apoplexy, paralysis, softening of the brain, or dropsy.

There are no known medicines which will cure the fatty degeneration of any organ. Thousands of deaths occur each year as the result of this one change, which takes place in the cell structure of the bodies of habitual users of alcoholic liquors. Fatty degeneration may be associated with general emaciation, as in the case of a raw-boned spirit drinker, or with the accumulation of great quantities of fat, as in the abnormally large abdomen of a beer drinker. In the latter

case, the excessive quantities of water consumed, and the alcohol, interfere so much with so many vital functions that it causes the over-fat condition so often observed. It is believed that this unusual fat does not begin to accumulate, until after fatty degeneration has begun in the liver.

While the whole body is suffering from the imperfect work done by the lungs, when under the influence of alcohol, the tissues of the lungs themselves are being more or less injured, not only by the general derangement, but also by the direct action of the alcohol.

The lowering of the vitality, and the deranged condition of the tissues, lead to many fatal cases of congestion and inflammation, and to *very many* cases of consumption. A peculiarly fatal form of this disease, which often attacks steady drinkers, has been known, for thirty years, as "drunkard's consumption."

We have already learned that consumption is a germ disease, and that anything which lessens the vitality and activity of the white corpuscles, increases the death-rate from germ diseases. This is especially true in regard to consumption. *It is not possible for any one habitually to use ordinary quantities of alcohol and have perfectly healthy lungs.*

RECAPITULATION.

Breathing is carried on by muscular con-

tractions which are lessened, both in force and frequency, by the action of alcohol. Alcohol has an affinity for the coloring matter of the trillions of red corpuscles which carry the life-giving oxygen to all the tissues. This injures or destroys the corpuscles and lessens the amount of oxygen taken to the tissues, interferes with the removal of waste and poisonous matters, lowers the temperature and vitality, and counteracts the good effects of exercise. While the alcohol is injuring the blood, it is also doing harm to the delicate membranes of the air-cells, causing much sickness and many deaths. The large quantities of water taken with the alcohol, or to quench the thirst caused by it, thins the blood, overworks the heart and interferes with the work of every other organ and tissue. The imperfect preparation of the food, and the imperfect work done by the lungs and other organs, while under the influence of alcohol, lead to a painless but very fatal disease of the liver, kidneys, brain, heart and other organs known as fatty degeneration. It is believed that fatty degeneration of the liver precedes the excessive and unnatural accumulation of fat, which is so frequently seen in beer drinkers.

Alcohol does not change into heat or any kind of force or energy, but acts directly up-

on the blood, and upon other tissue cells, thereby lessening heat production, and producing tissue degeneration. When given to the sick, it acts as an anesthetic, like chloroform or ether, serving to quiet the patients restlessness, lessen his consciousness of pain, and also favors the retention of both the cause and product of the disease. While the patient appears and feels more comfortable, the diseased and overburdened system is being compelled to remove an additional load. All this adds greatly to the number of fatalities.

CHAPTER VII.

HEADQUARTERS.

The whole nervous system is made up of cells, which generate nerve force and receive impressions, and of fibres, which convey these



Fig. 25.—Nerve-cells and fibres. Highly magnified.

forces and impressions to different parts of the body. The average size of the cells is about $\frac{1}{2000}$ th of an inch in diameter, while some of the fibres are only $\frac{1}{15000}$ th of an inch in diameter. Each cell has one or more fibres attached to it, to put it into communication with other parts of the body, much as every "cell" in a telegraph battery has connection by wire

with others. The brain weighs about fifty ounces. Its surface is covered to the depth of

one fourth of an inch with cells. An innumerable host of fibres pass from cell to cell, and to every part of the body, and these make up the white matter of this most wonderful of organs. In this outer layer of cells, is the seat of the mind. This envelope is so folded that it presents a surface of about four square feet. That is, the average person has about four square feet of mind, one fourth of an inch in thickness! Of course some brains are "smaller" and "thinner" than that. It is estimated that this part of the brain is composed of 500,000,000,000 cells. No wonder that the mind, especially a small one, occasionally wanders or gets lost. The whole brain is soft and gelatinous, containing 79 or 80 per cent of water, or rather more of this fluid than the blood. The work of this organ is so great and so important, that nearly one fifth of all the blood in the body is sent to it.

It has charge of, and controls more or less, every other organ and function of the body. When an impression is made upon any part of the body, as from poison in the stomach, or by an injury to the skin, information is at once sent to the brain, and it immediately attempts to send back along the nerve fibers the relief needed, and also to send a word of warning to all other endangered parts. This

perfect and constant intercommunication of the brain, and smaller nerve centers, with every organ and tissue of the body, is of absolute importance. The health and safety of every part, and the successful discharge of every function, depend upon this perfect adjustment of duties. The action of the whole nervous system depends upon that property of protoplasm which is known as sensibility or irritability—that which shows that it is alive. Therefore, anything which lessens the action or sensibility of the brain or nerves tends to dry up the very fountains of life.

When a medicine is taken into the system, its effects are measured by the manifestation of increased or diminished sensibility of the modified cells of protoplasm of the nervous system and of other tissues. Medicines are lifeless objects which never become a part of the living body, but are always expelled as intruders. The influence which the medicine has upon the cells of the body, while it is in contact with them, is known as its effects. It is not an active agent, but it modifies the activity of the tissues by its contact with them. When a medicine changes, by chemical action, the composition of the tissues, its effects are apt to be more marked and more enduring. Such remedies as strychnine and digitalis increase the activity of certain

tissues, while opium and aconite depress them, without causing important changes to take place in their structure. Medicines are given (at least *ought* to be given) to correct some departure from the natural activities of the cells. The disturbance of the life work of the cells—disease—may be produced by a poison, which changes their action or chemically changes their structure, or perhaps by some interference with the nutrition and life of the cells which is not yet explained. *It is not possible for an active medicine to pass through the tissues of a healthy body without doing harm. It cannot be of any benefit to them.*

After alcohol has been introduced into the stomach, and has passed through the liver, the right side of the heart, the lungs, and then the left side of the heart, it goes to every part of the body unchanged in its condition, the same as other poisons. As one fifth of the blood reaches the brain, so does one fifth of the alcohol. Immediately upon its arrival it not only begins its work of damaging this important and delicate organ, but it also commences the process of damning both soul and body. The fact that alcohol has a double action on the cells should not be lost sight of for a moment. It lessens that fundamental property of protoplasm called sensa-

tion, as does opium, aconite, and other narcotic poisons, and also acts as a chemical agent in extracting water from the cells, thus changing their structure. When there is an excited condition, alcohol has a beneficial effect by lessening the over active state of the cells. But while it is producing this desirable effect it is also doing untold harm in changing the structure of the cells and tissues. As there are many other medicines which are more useful as narcotics, or quieting remedies, and which do not have the active chemical affinities so manifest in alcohol, it is very evident that *alcohol is never the most desirable medicine to use under any circumstances.* It always does harm, for it is never desirable to produce the chemical change referred to. Whenever used as a medicine, the harm done may so outweigh its good effects that the experiment is of doubtful expediency, so long as there are other more useful and less objectionable remedies.

The above brief statements, together with what has been said elsewhere, make it certain that the following statements must be admitted as established and unchanging truths:—*Alcohol is never the most desirable medicine. It is never harmless in health or disease. It always produces disease.* These statements are especially true in regard to

the brain whose extremely delicate and sensitive tissues take notice of everything. The wonderful sensitiveness of the nervous system is best illustrated by the following statements, common in our text books on physics. A ray of red light has 39,000 vibrations or waves to the inch, and of violet, 57,500; the other colors of the rainbow have wave lengths intermediate between these, the average (green) having about 50,000 to the inch. There are 63,360 inches in a mile, and light travels at the rate of 186,000 miles per second, so that during each second, while we are looking at a green object, our eyes receive $50,000 \times 63,360 \times 186,000$ waves of light. A red object will give us a slightly less total number of waves, and a violet one a somewhat great total. If the nerves of the eye can distinguish between the slight variations in the total number of waves of light, as between indigo and violet, when they are being received at the rate of more than seven hundred trillions per second; if the ear can distinguish 38,000 different sounds; if, by the sense of smell, a dog can track his master through a city, even though the man has just put on a pair of new boots; and if the brain itself is capable of memory, thought, and an infinite amount of education, it seems quite safe to conclude that the brain and nerves are

injured every time they are under the influence of such a narcotic poison, and active chemical agent, as alcohol.

It is believed that the brain never fully recovers from the effects of a single intoxication. The harm produced by the habitual use of alcohol is in direct proportion to the length of time it is used and the amount consumed. But whatever be the amount, or length of time, there is always *some* harm done to the brain and body.

When a small amount of alcohol is taken into the stomach, it usually produces an agreeable sensation. The nerves of sensation are more or less paralyzed, quieting the complaints of the much abused organ, and the nerves which control the blood supply in the lining membrane are so paralyzed that the amount supplied is temporarily increased. The effect is much the same as that produced at the beginning of a warm meal; the individual feels better natured and more at peace with himself and all the world. The alcohol soon leaves the stomach and in a few moments has reached the brain, where the amount of blood is increased by reason of the same paralyzing influences. The increase in the amount of blood in the brain *seems* to increase mental strength and activity. But the appearances to others, and the sensations

to the individual, are as deceptive as are the appearances and sensations in regard to muscular strength. All narcotic poisons lead the individual, who is under their influence, to believe that the strength and activity of both mind and muscle have been increased. Dr. Lander Brunton says:—"The influence of alcohol upon psychical processes is curious, for while it renders them much slower the individual under its influence believes them to be much quicker than usual." The physiological effects of alcohol seem to be about the same now as they were three thousand years ago when Solomon wrote: "Wine is a mocker, strong drink is raging, and whosoever is deceived thereby is not wise."

Alcohol takes a part of the water from the cells and fibres, making the brain slightly more firm and compact, and a part of it passes into the brain tissues to unite with the water which remains there. This accounts for the fact that the brain retains more alcohol than any other organ except the liver. Of course these chemical effects are not so great as are the narcotic or stupefying effects. When larger quantities are used for a longer time the changes in the structure are well marked. The whole brain is somewhat smaller and harder, there is more fluid in the

ventricles, the membranes are thicker, and the cells smaller. Fatty degeneration may cause the rupture of a blood-vessel and sudden death, or this disease may cause softening of the brain and thus end the habitual drinker's life. The action of the brain, and the remainder of the nervous system, is affected as well as its structure, as is shown in a heavy lumbering gait, an unsteady hand, an irregular action of the heart, and in the general impaired state of the senses of hearing, seeing, smelling, tasting, and feeling.

The blood and brain contain almost the same proportion of water and solid matter.

One circulates rapidly as fluid, while the other retains as perfect a form as any of the more solid tissues of the body. No one has been able fully to comprehend the wonderful composition and manifold offices of the blood. What then shall be said of the efforts of the mind to comprehend itself and that most mysterious of all structures through which it manifests itself? The brain is so exceedingly delicate and sensitive that the twenty-fifth part of a grain of atrophine, or the fourth part of a grain of morphine, will produce a profound impression upon it, even when such almost invisible quantities of these medicines are mixed with the sixteen pints of rapidly moving blood. These impressions, amount-

ing to unconsciousness in many cases, are produced by the medicine, while in contact with the protoplasm of which the brain cells are composed. If the brain cells are so sensitive that a quantity of vegetable matter not half the size of a pin's head, and diluted by so much blood, will so modify their action as to amount to almost a temporary annihilation of that manifestation called mind, what then must be the effect of an introduction of large quantities of a substance which not only interferes with the proper action of the cells, upon whose activity the mind depends, but also attacks their structure as a chemical agent? The action of the whole nervous system (whether natural or otherwise) is the foundation element in health and disease. So the action of the cells of the brain is the foundation of the health and disease of the mind. Any substance which interferes with the action of the brain must interfere with the mind. This is doubly true of any substance which combines the properties of a narcotic poison and an active chemical agent, so that both the action and the structure are modified by its use. THEREFORE, IT IS NOT POSSIBLE FOR ANY PERSON ADDICTED TO THE USE OF ALCOHOLIC LIQUORS TO HAVE A PERFECTLY HEALTHY BRAIN AND A PERFECTLY SOUND MIND.

Some of the painfully frequent manifestations of deranged minds caused by the habitual use of alcohol, are ill-temper, despondency, loss of moral sense, brutality, monomania, delirium tremens, insanity, and idiocy. It is strange that anyone can be so foolish as to believe that no permanent harm can be done by a substance which has the property of annihilating, so completely, the powers of both the mind and body, as is seen in a case of intoxication. If a medicine has power to change the structure or action of parts of the body in disease, beneficially, it also has power to make changes in a healthy body. If the healthy body is changed, either in structure or action, to that extent, it is changed from a healthy condition, and is therefore, diseased. All active medicines are not only *not* harmless to the healthy, but are active poisons.

The Creator has given to our organs and tissues a wonderful amount of ability to adjust themselves to varying conditions and circumstances, and to repair much of the damage that may be done them in any way. Those functions of our brains and bodies which develop as a part of our existence, such as digestion, secretion, and excretion, are called natural. All these functions are carried on by the combined activities of the

cells which compose the several tissues; all mental activities by the cells of the brain; secretion and excretion by the epithelial cells which cover the organs intended for these purposes; all muscular movements by the contraction of the cells of the muscular fibres; and so on throughout the whole body. When the nervous system reports that all the cells of the body have their wants supplied, and that they are doing their work properly, then there is perfect health, and life is a joyous reality. When the nerves report that there is injury, want, or unnatural action, in any part of the body, then there is distress or disease.

Education of the mind and body is simply the process of encouraging the cells to do a thing so many times that it becomes a second nature. That which is done so many times that no further effort is required to keep it up, is called a habit. Habit may refer to an action of the mind, as thought or conduct; to that of the muscles, as shown in unnatural attitudes assumed in standing, or walking; or to the work done by the cells and tissues when disposing of unnecessary quantities of food and drink, toiling under the influences of poisons, or calling for accustomed quantities of food and drink at regular intervals. Habit, then, is an acquired or second nature, and becomes more powerful than the first na-

ture, which it has overcome and displaced. Education, whether good or bad, and from whatever source, is the forming of a habit of doing, in a seemingly natural way, that which is not quite natural. Interfering with a habit is going contrary to the acquired nature, and it produces more or less inconvenience, even positive suffering. If the cells have been doing their work for a long time under the influence of a poison like opium, tobacco, or alcohol, and then the influencing agent be completely withheld, the cells will send up a protest against the interference, often amounting to unendurable agony. Until the cells can adjust themselves to the changed conditions, they are as uncomfortable as a wasp-waisted lady of fashion would be, if she should leave off her "stays." Habit, being a quality, or condition, of our bodies, acquired by use, then, under the law that all vital actions tend to repeat themselves, and to be more easily performed the more they are repeated, it is easy to understand how one may grow until it is all-powerful in an individual's life. When a glass of any alcoholic liquor is taken, it feeds and strengthens only one thing—a growing habit. It is one more lesson in the education of a second nature which may become stronger than the first nature, and displace it. As the habit grows

stronger, the powers of the body and mind grow weaker from the narcotic and chemical effects of the poison. The desire to be a man among men, the sense of duty to one's family and country, the moral sense, abhorrence of evil, love of home and family, fear of the consequences of an evil life to both body and soul, are all lowered, and finally paralyzed, by the same agent which feeds and strengthens the habit. Few take into account that, along with the growing habit, there is a constant failing of power to resist, and thus millions have been wont to cry out for help when it was too late. No young man should be so fool-hardy as to believe himself wise in such matters, and so much stronger in mind and body than most of his fellow-men, that he can do with safety that which experience proves to be utterly ruinous to many, and science proves to be injurious to all.

CHAPTER VIII.

THE COMING MAN.

Each individual, of all the higher species of animals, begins its life history as a single germ-cell which has been profoundly impressed by a sperm-cell that has become a part of it. The sum total of all future possibilities is then wrapped up in this one fertilized cell—this minute speck of protoplasm. This cell is capable of taking food and producing other cells, which can also take food and produce still other cells, and so on till the largest and most complicated being is built up. The full grown animal then is the resultant of two sets of forces, one being made up of the influences of the life histories of all its ancestors, and the other, of all the forces which acted to modify the development of the cell into the mature animal. Every stock-breeder is guided by these universal laws of nature. He knows full well that like produces like in more than one sense of the word.

He also knows that such influences as temperature, food, exercise, and fear, have much to do with the development of the animal, both before and after birth.

When an animal acquires vicious habits, it is considered unfit for breeding purposes, because of the liability of transmitting the same characteristics to its descendants. Varieties of dogs have been trained to do a certain thing till it has become a second nature, and more or less of this acquired knowledge has been transmitted to the next generation. The pointer, setter, retriever, and watch-dog, are examples of transmitted and fixed specialities. The great difference between the domestic animals, and the wild ones from which they have descended, both as to habits and in the structure of their bodies, proves that training and other influences have much to do in determining the life history of individuals of succeeding generations. The differences seen in human race characteristics show how the body and mind may be modified by surroundings and habits, for, all mankind started from a common stock. The difference then between the thoroughbred and the scrub is one of inheriting the effects of care, or of neglect. The difference between the instincts of a watch-dog and a greyhound is one of inherited education.

No stockman expects good results if he is foolish enough to breed from sick, half-starved, over-worked, or ill-formed animals, or from good stock kept in unhealthful buildings or fed upon unwholesome food. If one or both of the cells, uniting to form the cell which is the beginning of the animal's life, are weak or imperfect from any cause, or if the conditions before or after birth are unfavorable to development, then the individual will be more or less defective in body and mind. Each animal inherits much of what its parents inherited, some of what the parents acquired themselves, more or less of the conditions of both body and mind of the parents when the life of the first cell began, and the results of the influences brought to bear upon the mother's life before its birth. Every wise and successful stock-breeder acts upon his knowledge of these recognized and never-failing laws of heredity *only* while endeavoring to improve his herds. Of late, scientists and other thoughtful people are beginning to recognize the great importance of applying these well-known laws of heredity to the improvement of the human animal. The great mass of humanity, however, have not even considered such a thing.

It is a well-known fact that a person without any inherited tendencies towards a disease,

may contract one, such as consumption, and afterwards impart to his off-spring an enfeebled constitution, with grave liabilities toward the development of the same disease. This is as true regarding those diseases and diseased conditions which are developed by the voluntary acts of the individual, as it is of those which are inherent and unavoidable.

Much has already been said regarding the disastrous effect of alcohol upon the tissues and functions of the body and brain, but the most awful of these frightful statements is yet to be made. *The evil effects produced by the habitual use of alcohol are hereditary.* Whatever changes are made in the physical features, or mental condition, will appear to a greater or less degree in ones descendants for one or more generations. In the case of the alcohol user, the sins against the laws of nature are often visited, in a most fearful manner, upon his children to the third and fourth generation. Such passions as anger, fear, and jealousy, and the tendencies to gluttony and drunkenness, are liable to be transmitted to offspring by direct constitutional inheritance, especially if both parents are alike affected.

Alcohol not only changes men and women of brilliant minds to demented beings, but may so change the vital powers of an infant,

before it sees the light of day, that its after life will be a misery to itself and a mockery to the state of civilization around it. That form of drunkenness known as *dipsomania*, which breaks out, from time to time, into uncontrollable paroxysms, is a prolific cause of idiocy, suicidal mania, and insanity among the children of those thus affected. It is believed that fully one half of the idiots and imbeciles of large cities have had parents who were notoriously drunken in their habits. Dr. Howe, of Mass., cites the case of a drunkard who was the parent of seven idiots. Where the inheritance does not take the form of some well defined disease, it often appears in a defective physical development or a mental weakness predisposed to intemperance or to disease. Dr. Parker, of New York, says that over ninety per cent of the children, born in the slums of that city, die before the end of their first year. This fearful mortality is largely due to enfeebled constitutions inherited from drunken parents.

Scientists have just made a very interesting and valuable discovery, which shows clearly that impressions which are made upon the cells of the parent's body, will modify the life-history of the offspring. It has been proven that the immunity against certain germ diseases, which has been acquired by innocula-

tion, is inherited by the offspring. This is found to be true in the case of either parent. These statements do not seem so surprising when we remember that every cell of the young animal does just the kind of work that was done by the corresponding cell in the parent's body.

If the cells of the parent body acquire the habit of secreting a substance which is so disagreeable or poisonous to disease germs that they will not multiply in it, why should not the cell of the offspring do the same thing? Past generations are largely responsible for the criminals, cranks, lunatics, and imbeciles of the present. Every child should inherit a sound body and a sound mind. If it does not, it has been robbed of that which is a thousand-fold more valuable than millions of money. The parent who squanders the family inheritance, and leaves his child a pauper, is called a scoundrel. But when he squanders his powers of body and mind, and entails upon his child a physical and mental bankruptcy, the whole matter is very *unkindly* attributed to the dispensations of a "kind (?) providence."

In *Modern Medicine and Bacteriological Review*, for March, 1894, Dr. Kellogg says:—"That these weaknesses and abnormalities of body and mind are perpetuated by heredity,

is no longer a question upon which there is any difference of opinion. It is as clearly settled that mental and moral characteristics are inherited as that the color of the hair and eyes, or other physical characteristics, are thus derived. It is equally true, although the fact is often forgotten, that the resemblance of the internal structures of the child, to those of his parents, is as close as the likeness which can be traced in the external features. Heredity is a force which operates in the most thorough-going manner. Every human being is the product of a principle which has been taking careful notes of the lives and habits, the neglects, the excesses, and the abuses, of every crime against the body, through all the generations from Adam down to the individual man in question."

In *The American Medical Temperance Quarterly*, for April, 1894, we find the following taken from a lecture by Dr. T. D. Crothers:—"A careful study of many cases by various observers shows that heredity is the most prominent cause and is present in over 80 per cent of all inebriates. Another active factor, more apparent and controllable in the problem of inebriety, is that of marriage. At present the indiscriminate marriages are largely influential in intensifying the alcoholic stream. Criminals, paupers, inebriates, and

others, notoriously far down on the road to dissolution, are permitted to marry and raise children freighted with a truly frightful legacy of degeneration. It is this defective heredity, increased and intensified by marriages with equally bad stock, that is the great fountain-spring from which inebriatecy comes. Alcohol, of all other drugs, seems to intensify and provoke disease and the most favorable conditions for the destruction of cell and nerve force."

It is not expected that a defective machine will do perfect work. Neither should a defective organ or body be expected to act perfectly. If the production of new cells be the required work of an unhealthy body, then it is reasonable to expect that the cells will be more or less imperfect. But if these new cells are destined to become the beginnings of new lives, it is reasonable to believe that these new lives will be more or less defective in their very beginnings. If it be the work of an unhealthy stomach and liver to prepare proper food for the growing cells, it is also reasonable to believe that the cells will not be properly nourished.

If the one cell which begins a new life be formed of two cells, one or both of which have been developed in unhealthy bodies, or,

if all the nourishment which it receives while producing other cells and arranging them into nerves, muscles, bones, glands, and brain of a being "made in the image of God," be prepared by unhealthy organs, it is not unreasonable to conclude that many children are born with defective bodies and unbalanced minds, because of the unhealthy condition of one or both of the parents. But, when we see added to all this the potent influences of a narcotic poison and active chemical agent, deranging the whole body by interfering with the work of every organ and injuring every cell, we are certain that the habitual use of alcohol, even in *moderate quantities*, is the fruitful cause of much of the feebleness, deformity, disease, and death, among infants, and of the evil tempers, bad tendencies, stupidity, epilepsy, hysteria, insanity, and idiocy, of older children. When the influence of the evil spirit (the devil in solution) which causes such diseases and tendencies to be inherited, is added to those already in force in each generation, the successive generations will have to suffer, more and more, the consequences of such acts which, if not checked ere long, will result in the extinction of the whole family.

If the laws of heredity are so unfailing that a part of a dog's education appears as a part

of the instinct of the next generation, no doubt that the change in the structure and functions of the organs, the profound impressions upon every cell of the body produced by alcohol, have much to do in shaping the future destiny of the coming man (or woman) both in time and eternity.

CHAPTER IX.

JUG-OR-NOT'S YOUNGER BROTHER.

Physicians, botanists, and chemists unite in pronouncing tobacco the most deadly poison known, with the exception of prussic acid. Its poisonous properties are due to a heavy, oily substance, called nicotine. This substance is so active that it produces unconsciousness in thirty seconds, and a total extinction of life within three minutes. Less than a drop will kill a dog in ten minutes. Small birds are quickly killed by inhaling its fumes. These statements can be verified by anyone who desires to experiment with this dangerous poison.

The proportion of nicotine in tobacco varies from two to eight per cent, the average being about five per cent, or 384 drops in each pound. This amount is sufficient to destroy 200 men or 400 dogs.

At least 500,000,000 pounds of tobacco are consumed each year in this country, or an

average of about 36 pounds for each family. Now, if each of the 14,000,000 families of this country were to keep 3,595 boarders, and 7,200 dogs, the families, their boarders and their dogs could all be destroyed, in ten minutes, by the nicotine which could be extracted from the amount of tobacco annually consumed. In other words, the raw nicotine in a year's supply of tobacco is sufficient to destroy 50,000,000,000 people and 100,000,000,000 dogs, provided both kinds of animals were not accustomed to its effects. The people of the United States consume about one-ninth of what is produced in the whole world, (4,500,000,000 pounds annually.) There is nicotine enough in these four and one-half billion pounds of average tobacco to depopulate 60 worlds. The nicotine in one week's supply of tobacco would kill, in six minutes, every man, woman, and child on the face of the earth, provided none of them were accustomed to its effects. A single cigar contains enough of the poison to kill two men. Tobacco smoke is so poisonous that it will kill an infant almost instantly. When a small piece of tobacco leaf is laid upon the tongue of an adult, or a small amount of smoke is inhaled, alarming symptoms of acute poisoning appear in less than twenty minutes. The skin becomes cold and clammy, the pulse

quick and feeble, there is a death-like pallor, dizziness, faintness, nausea, vomiting, and sometimes convulsions ensue which terminate in death. When the body is examined after death, a remarkable pallor of the tissues is found. The lungs appear greyish and are so dense that they sink in water instead of floating as usual. The heart and brain are engorged with a very dark blood. The stomach presents some slight traces of inflammation, some effusions of blood, and occasional spots which appear like bruises. Children are much more susceptible to the poisonous effects of tobacco than are adults. Carelessness and the desire to form the tobacco habit, result in hundreds of fatal cases of acute nicotine poisoning, annually.

The human system possesses the wonderful faculty of accommodating itself to circumstances. This makes it possible for the cautious beginner gradually to increase the quantity used until an enormous amount can be used daily without immediately fatal effects. When the system becomes accustomed to its use, the injurious effects are not so apparent; many being able to resist its bad effects for a long period, a very few living to extreme old age. But the great majority of people are not able to use tobacco in any form without *noticeable* injurious effects. It

is believed that not less than twenty-five thousand lives are lost, each year, in the United States, from the effects of using this most poisonous substance. It undermines the constitution, weakens the heart, lessens the sensibility of the nervous system, interferes with digestion, deranges the blood, and wastes the vital energies. The mischief which has been wrought often goes unnoticed until some extra strain is brought upon the system, such as some great mental or physical exertion, an attack of pneumonia, fever, or some other severe disease. Then the constitution breaks down like a worm-eaten bridge, sound to all outward appearances but going to pieces under an additional load.

The evil effects of chronic nicotine-poisoning upon the youth of this country, are partially set forth in that prince of medical journals, *The Bacteriological World and Modern Medicine*, for Dec., 1891, page 66:—"Dr. Jay W. Seaver, medical director of the Yale gymnasium, and professor of physical culture in Yale University, has been making a careful study during the last eight years, of the influence of tobacco upon development. His statistics show that non-smokers were 20 per cent taller than smokers, 25 per cent heavier, and have a lung capacity 66 per cent greater. These figures are wonderfully significant, es-

pecially the last. A man who has a lung capacity two thirds greater than that of another man has an immense physical advantage. His prospects for long life are greater, and his physical efficiency will be certainly as much greater as his breathing capacity. A man with small lung capacity is like a furnace with a small draft. All his vital activities must be inferior to those of a man of greater lung capacity.

Similar observations have been made at Amherst college, with like results. In a recent graduating class, the non-smokers were found to have gained in weight over the smokers nearly one fourth. The non-smokers surpassed the smokers by a gain in height of 37 per cent, in chest circumference 42 per cent, and lung capacity 8.36 cubic inches (about 75 per cent.)

Science recently published the results of an experimental inquiry into the condition of thirty-eight boys of all classes of society, of average health, who had used tobacco for different periods ranging from two months to two years. Of the thirty-eight, twenty-seven showed severe constitutional injury and stunted growth. In thirty-two there were irregularities of the heart action, stomach disorders, cough, and a craving for alcoholic liquors. Thirteen had intermittent pulse, and

one had consumption. All were induced to discontinue the use of tobacco, and as a result, in six months one half were free from their former symptoms, and by the end of the year the entire number had recovered, thanks to nature's recuperative forces. * * Hundreds of thousands of persons are living in a state of chronic poisoning from the use of tobacco. Their vital powers are depressed to such an extent that their physical, mental, and perhaps moral efficiency are vastly inferior to what they might be without the depressing influence of this toxic incubus.

The evidence of these statistics is overwhelmingly convincing, and ought to set every intelligent young man who is beginning to patronize the pipe or cigar to thinking earnestly whether he can afford to subject himself during the best part of his life to chronic nicotine poisoning."

The statements of Dr. Seaver, of Yale, are based upon observations made and compiled from the records of a class of 187 men during their four years college course. Such reliable statistics, as those above quoted from Yale and Amherst, are quite rare and very valuable. It is believed that no person who uses tobacco, during the growing period of his life, ever fully develops, either physically or mentally. The tobacco-using school boy seldom succeeds as

a student, and very seldom develops into a useful, prosperous, and happy man. He is often careless regarding his personal appearance and of the wishes and rights of others, becomes nervous, ill-tempered, sluggish, and fearful of impending danger. This fear of future calamity, sometimes develops into such a state of horror that it leads to suicide.

Dr. L. Bremer, late physician to the St. Vincent's Institution for the Insane, at St. Louis, in a paper read before the St. Louis Medical Society, said:—"It may look like overstating and exaggerating things, but I know whereof I speak, when I say that tobacco when habitually used by the young leads to a species of imbecility; that the juvenile smoker will lie, cheat, and steal, which he would not, had he let tobacco alone. This kind of insanity I have observed in quite a number of cases at the St. Vincent's. The patients presented all the characteristics of young incorrigibles. They had exhausted the indulgence of their parents, who saw no other way to protect them from their insane pranks, than to commit them to the institution.

I do not know whether a lasting improvement was effected in any of them. There was not one amongst them that was able to comprehend that tobacco was injuring him; they

were constantly on the lookout for obtaining it, by begging, stealing or bribing, and regarded the deprivation of the drug as a punishment. The sense of propriety, the faculty of distinguishing between right and wrong, was lost. The father of one of them who looked upon his son only as an aggravated case of bad boy, told me that he himself had been smoking ever since his 10th year and it never had affected him. In reality, being only 45 years old, he was a wreck, physically and mentally, though he came of healthy stock. He could not or would not comprehend that tobacco was gradually undermining his own mind and body, although his wife and his friends knew and saw it."

When tobacco or tobacco-smoke is taken into the mouth it greatly increases the flow of saliva and exhausts the glands of the mouth, leaving the mouth and throat in a more or less inflamed condition. This irritated condition of the throat is usually mistaken for thirst. As the supposed thirst is not relieved by water, but can be subdued by alcohol, it is not uncommon for the tobacco user to become an alcohol drinker. In fact, very many of those who learn to use one narcotic poison soon learn to use *more* than one.

Tobacco interferes with digestion, circula-

tion, respiration, and other vital processes, to such an extent that the user is generally several pounds lighter than what ought to be his usual weight, many even becoming greatly emaciated. Those who best resist the bad effects of tobacco are possessed of great physical endurance, but it may be said that they are not always endowed with great mental ability. Dyspepsia, diseased heart, nervousness, general debility, anxiety, "blue devils," and insanity, to which all tobacco users are liable, and from which so many suffer, detract greatly from the sum total of human health and happiness.

Fig. 26 represents the pulse of H. F. C. (see descriptions of Figs. 19, 20 and 28) as affected by smoking two cigars, after abstaining from the use of tobacco for ten days.

A trace was taken every five minutes. He began smoking after the first trace was taken, stopping at the fourteenth. The pulse rates were; 84, 90, 97, 99, 100, 99, 101, 102-101, 104, 103, 102, 104, 106, 105, 102. For each fifteen minutes after taking the last trace, the pulse rates were; 92, 86, 84, 89, 83, 80, 84, 85, 83, 83, 80. At the close of this latter period, or two hours and fifty-five minutes after the second cigar was finished, the elevations in the trace taken were not one-third as high as those in the traces of the na-

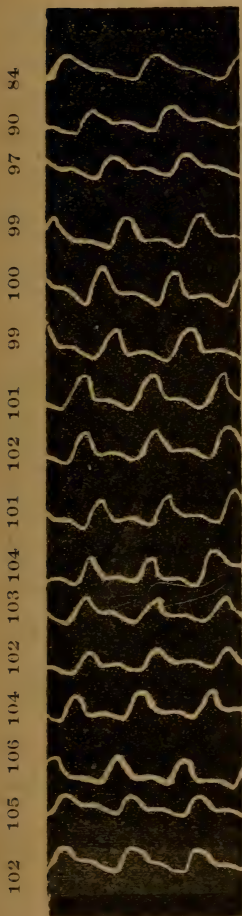


Fig. 26.

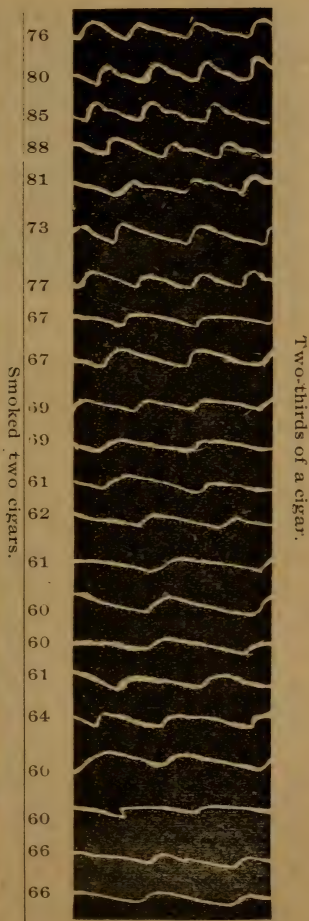


Fig. 27

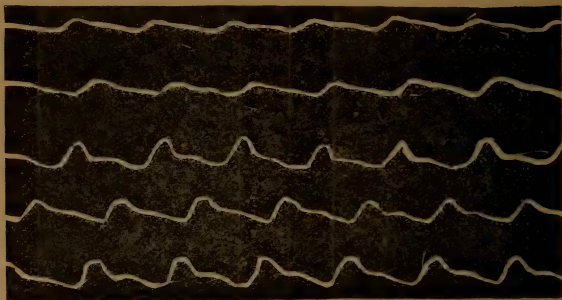


Fig. 28.

tural pulse at the beginning of the experiment. When the second cigar was finished, the heart was so affected that it was running at the rate of 31,680 more beats per day than natural. The spasmodic action of the heart, when under the influence of tobacco, is nicely illustrated by some of the traces. The two cigars did not produce sickness. Fig. 27 represents the pulse of I. H. O., age, 47, weight, 132, during the early part of his experience in smoking (two-thirds of) "his first cigar."

The traces were taken five minutes apart, except the last three, each of which was taken fifteen minutes after the preceding one. The pulse rates were: 76, 80, 85, 88, 81, 73, 77, 67, 67, 69, 69, 61, 62, 61, 60, 60, 61, 64, 60, 60, 66, 66. He began smoking after taking the first trace, and smoked about two-thirds

of a "mild" (?) cigar during the next twenty minutes. Began to feel sick in five minutes; much worse in ten; nausea and pallor in fifteen; sweating, trembling, and death-like pallor at the end of twenty minutes, with an "awful feeling in the stomach." Vomited at the end of the next five minutes. The trembling continued for forty minutes after he stopped smoking. At the close of the experiment, which lasted two and one-fourth hours, the man was able to walk, being still pale, sick, and weak. He had not fully recovered the next day. The writer has some vivid recollections regarding this experiment—some of the most vivid of a life time. Fig. 22 represents the natural pulse of the same person. A very careful comparison between Figs. 22 and 27 will be of great value and interest. Fig. 28 represents the "natural" pulse of H. F. C. taken on five separate days. (See Figs. 19, 20, and 26.) The first trace was taken one and one-half hours after smoking his last cigar. The second three days later. The third three days later. The fourth one day later. The fifth three days later, or ten days after the habit of smoking three or four cigars daily was discontinued. The evil effects of even a mild form of the tobacco habit, and the marked and speedy recovery (of the young) when the habit is discontinued, is so

apparent that comments are unnecessary. The five traces are a most powerful and interesting object lesson.

If society were so constituted that each person using the weed was compelled to enjoy (?) *all* the effects of his own habit there would be less reason for writing this chapter.

Millions are more or less injured every day by inhaling tobacco smoke and the poisonous breath of the confirmed and saturated tobacco inebriate. Many young children and a few adults have lost their lives by being compelled to breathe air which had been thus poisoned by other people. But this is not all. The evil effects which are always produced in the parent by the habitual use of tobacco are, to a greater or less degree, transmitted to his children. Dr. J. H. Kellogg, in *Man, the Masterpiece*, page 306, says:—"There is no vice or habit to which men are addicted, whose results are more certainly transmitted to posterity than are those of tobacco-using. A vigorous man may use tobacco all his life, and be able to convince himself all the time that he is receiving no injury, but the children of that man, who ought to inherit from him a vigorous constitution and high health, are instead robbed of their rightful patrimony, and enter upon life with a weakly vital organism, with a system predisposed to

disease and destined to premature decay. The sons of an inveterate tobacco-user are not as robust as their father; and the grandchildren, in case the children are tobacco-users, are certain to be nervous, weakly, sickly creatures. This fact we have verified in so large a number of cases that we make the statement fully prepared to maintain it by indisputable facts."

The writer is well acquainted with a family in which there are four idiotic children. The father's excessive use of tobacco was the only cause of this terrible calamity that could be discovered when making a careful examination of the case. He became a mental and physical wreck, ending his life in the poor-house. It is not reasonable to expect that a being with every tissue and cell benumbed, deranged, and poisoned with such a deadly drug as tobacco, can be the progenitor of offspring, healthy in body and sound in mind.

The following partial summary will give the reader only a limited idea regarding the extent and importance of this subject. Tobacco is the most poisonous product of nature. (Prussic acid being a manufactured article.) It exhausts the glands of the mouth and produces a dry, irritated, and inflamed throat. It interferes with the action of the stomach, producing dyspepsia. It produces

weakness of the muscular walls of the stomach, resulting in the enlargement of this important organ. It deranges both the structure and function of the liver. It lessens the ability of the lungs and red corpuscles to do efficient work. It stupefies the white corpuscles, allowing sickness to increase and also the number of deaths from germ diseases. It weakens both the nerves and muscles of the heart, leading to palpitation, weak heart, heart failure, and death.

It weakens and deranges the brain, leading to nervousness, "the blues," "the horrors," insanity, and suicide. It weakens every muscle, and deranges every organ and function, producing languor, general debility, stupidity, carelessness, diminished activity of body and mind, *laziness*. It leads to the use of alcoholic liquors, and makes the reformation of the drunkard doubly difficult, and the permanency of his reform very doubtful, if not impossible. It is a prolific cause of bronchitis, consumption, cancer, impotency, deafness, loss of sense of smell, sore eyes, short-sightedness, blindness, loss of voice, epilepsy, delirium tremens, paralysis, spinal weakness, death. The habitual use of tobacco stunts the growth of body and mind in the young, and causes much nervousness, unhappiness, and sickness among all classes.

The evil effects on one generation reappear in the next in the form of enfeebled constitutions, nervousness, ill-temper, weak-minds, idiocy, and insanity. Tobacco smoke, and the breath of the tobacco user, are poisonous, leading to sickness, and sometimes death, when breathed by infants or others who are very sensitive. The tobacco habit is unsocial, filthy, disgusting, offnsive, and expensive, a nuisance without an excuse, poisonous, criminal, and deadly. It interferes with the physical, social, financial, and moral development of the world. Nature never intended that the mouth should convey smoke, or be smoked, or that man should chew a cud. The use of tobacco is a crime against self, against society, and against nature. It ought not to be tolerated anywhere for a single day.

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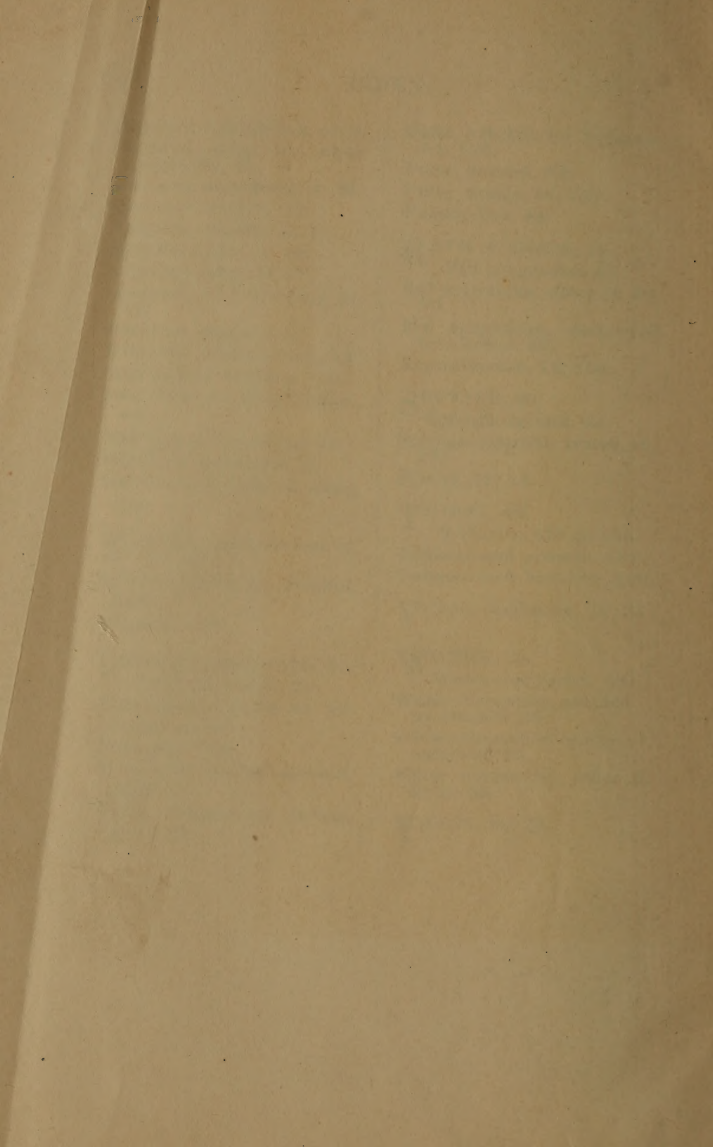
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